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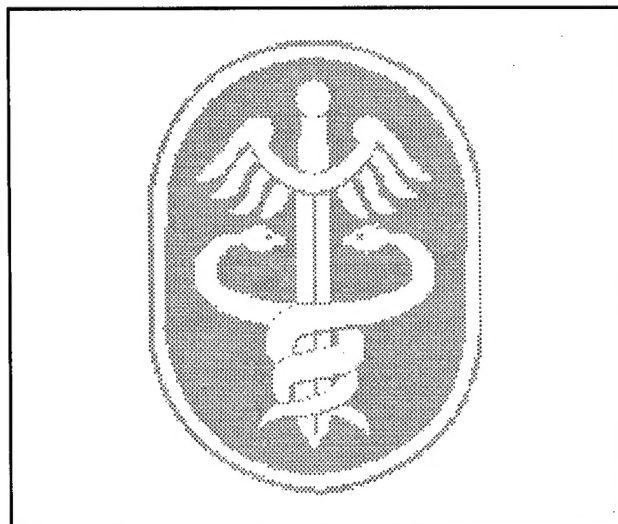
**USACERL Interim Report 96/79  
July 1996**

# **Investigation of Alternatives to an Equipment Assembly Structure for a MAMC/MAXIMO Data Base**

by  
James H. Johnson

The Madigan Army Medical Center (MAMC), Fort Lewis, WA, has been designated by the Army Medical Command (MEDCOM) as a Medical Facilities Management Center of Technical Expertise. This Center is currently responsible for investigating and proposing an Army-wide Hospital Maintenance Management System (HMMS) for Service Medical Centers and Hospitals. MAMC previously developed a local HMMS based on the (commercially available) MAXIMO Maintenance Management Program. This experience has contributed to the initiation of a configuration proposal for a General Service HMMS.

This initial stage of research reviewed the MAMC/MAXIMO data base currently in use at Madigan Army Medical Center and verified its potential effectiveness for general use at Army hospitals. This study concludes that, with limited adjustments, the MAMC/MAXIMO data base may be "upgraded" to an optimal level for general Army hospital use. This study also found that a re-engineering of the Equipment Assembly Structure (EAS) is a key element for achieving an effective MAXIMO Program process, efficient user interfaces, and refined report/printout generation. With this system, HMMS users may conform to Command EAS Network standards, while adapting Operations EAS Network guidance to their local needs.



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The Madigan Army Medical Center (MAMC), Fort Lewis, WA, has been designated by the Army Medical Command (MEDCOM) as a Medical Facilities Management Center of Technical Expertise. This Center is currently responsible for investigating and proposing an Army-wide Hospital Maintenance Management System (HMMS) for Service Medical Centers and Hospitals. MAMC previously developed a local HMMS based on the (commercially available) MAXIMO Maintenance Management Program. This experience has contributed to the initiation of a configuration proposal for a General Service HMMS.

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## Foreword

This study was conducted for Madigan Army Medical Center (MAMC) under Military Interdepartmental Purchase Request (MIPR) No. 5MCERDH036; "MAMC Hospital Maintenance Management System (HMMS) Design Proposal for U.S. Army Medical Command (MEDCOM) Acceptance and DA/DOD." The technical monitor was John Williamson, MCHJ-FMD.

The work was performed by the Industrial Operations Division (UL-I) of the Utilities and Industrial Operations Laboratory (UL), U.S. Army Construction Engineering Research Laboratories (USACERL). The USACERL principal investigator was James H. Johnson. Ralph E. Moshage is Acting Chief, CECER-UL-I; John T. Bandy is Operations Chief, CECER-UL; and Gary W. Schanche is Chief, CECER-UL. The USACERL technical editor was William J. Wolfe, Technical Resources.

COL James T. Scott is Commander and Acting Director, and Dr. Michael J. O'Connor is Technical Director of USACERL.

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# 1 Introduction

## Background

The Madigan Army Medical Center (MAMC), Fort Lewis, WA, has been designated by the Army Medical Command (MEDCOM) as a Medical Facilities Management Center of Technical Expertise. This Center is currently responsible for investigating and proposing an Army-wide Hospital Maintenance Management System (HMMS) for Service Medical Centers and Hospitals. MAMC previously developed a local HMMS based on the (commercially available) MAMC/MAXIMO Maintenance Management System Program. This experience has contributed to the initiation of a configuration proposal for a general service HMMS.

An important aspect to the proposal is tracking and reporting maintenance activities and costs by "zone." The MAMC hospital/clinic environment includes a dozen geographical or functional zones, diverse system maintenance activities, and a cost/charging status that must be tracked in each zone. Summaries from all zones should in turn be summarized in roll-up (totalized) values to MAMC management for internal evaluation and eventual MEDCOM/DA submittal.

A precondition to this work was that the proposal should maintain a flexible balance between maintaining existing practices at MAMC, and identifying better ways to meet the installation's needs, to use its capabilities fully, and to suggest constructive ways for incorporating lessons learned from this investigatory stage. An initial area of study in the project was to review the MAMC/MAXIMO data base to verify its effectiveness for general use at Army hospitals, specifically focusing on the Equipment Assembly Structure (EAS) format on which well-ordered MAXIMO summary reports and printouts depend.

## Objective

The overall objective of this study is to re-engineer the EAS of the MAMC/MAXIMO data base to meet the current and future needs of an automated Hospital Maintenance Management System (HMMS) for Army Medical Centers. The specific objective of this initial stage of research was to review the MAMC/MAXIMO data base currently in use

at Madigan Army Medical Center to verify its effectiveness for general use at Army hospitals.

## Approach

1. The current MAMC/MAXIMO data base was investigated to identify opportunities for innovation and improvement.
2. The Equipment Assembly Structure (EAS) of the MAXIMO Program was researched as a potential tool for the development and control of Maintenance Management System reports and printouts.
3. At the EAS operations level, potential candidates for EAS upgrade were identified.
4. Alternative EAS networks were investigated for their abilities to meet the special HMMS requirements of MEDCOM installations other than MAMC.
5. Conclusions were drawn and recommendations made to guide further development of an HMMS for application at this location and Army-wide.

## Scope

It was determined that a carefully prepared MAXIMO data base *requires* a carefully constructed EAS Network; as a first step, this study investigated, adapted, and developed an EAS Network from an on-line system under test at MAMC. These customized capabilities facilitate the retrieval and processing of data related to structural and maintenance operations at this specific data base location.

## 2 Re-Engineering the EAS

### Assumptions

This study assumes that the MAMC Facility Management Division (MCHJ-FMD or FMD) at Fort Lewis, WA will be the sole site for MAMC/MAXIMO data base design/development approval, test, and evaluation. It is further assumed that modifications to the MAXIMO Program and its functions, as installed and proven at the MAMC FMD, will be held to a minimum. Hence, the current EAS data base field (size) and its programmed relationships in the MAXIMO Program are to be retained.

### Background

The MAMC Facility Management Division (FMD) has been designated by the U.S. Army Medical Command (MEDCOM) to be a Medical Facilities Management Center of Technical Expertise. Appendix A more fully describes the MAMC configuration and command structure, HMMS areas of responsibility, duties performed, and the relationships between MAMC and Center activities.

#### *The HMMS Plan*

Currently, this Center is responsible for investigating and proposing to MEDCOM an automated Army Hospital Maintenance Management System (HMMS) Development Plan for MEDCOM's many medical installations. The MAMC/MAXIMO data base associated with the MAMC HMMS was originally developed cooperatively between the MAMC DPW Health Care Support Division under the Fort Lewis DPW, USACERL, and Project & Software Developments Inc. (PSDI). It is an implied objective that the HMMS plan will use the MAMC-FMD experience gained in previous HMMS development and implementation activities.

#### *MAXIMO Program*

The existing MAMC HMMS uses the commercially available MAXIMO Maintenance Management Program. The basic System Flow of the MAXIMO Program is a factory-oriented "Maintenance Management System" platform (Figure 1).

(This software is not compiled and has been adapted and modified to meet MAMC needs and anticipated MEDCOM/Army/DOD requirements.) The flowchart shown in Figure 1 shows that MAXIMO addresses key plant maintenance concerns that are also of interest to Army hospital facility and equipment upkeep. Process monitoring/control and data collection/ordering/storage are overall capabilities. "Work Order" procedural steps are tracked from receipt to completion-closing or cancellation; associated resource scheduling and direct dispatch control are also provided. Demands on supply are considered through an inventory tracking and purchase monitoring system. All of these operations data can be customized to user needs. These categorized data are collected, processed, and displayed in forms meaningful to the involved processes.

Figure 2 shows the impact of the MAXIMO program on MAMC FMD maintenance operations and how the MAXIMO MMS system fits conceptually into the total scheme of things. The MAMC/MAXIMO data base supports:

1. System/equipment status information for continuous facility engineer (FE) monitoring, and quarterly or year-end summary reporting
2. Selected control/operations data for command review and MEDCOM submittal
3. Customer charge computation and billing outputs.

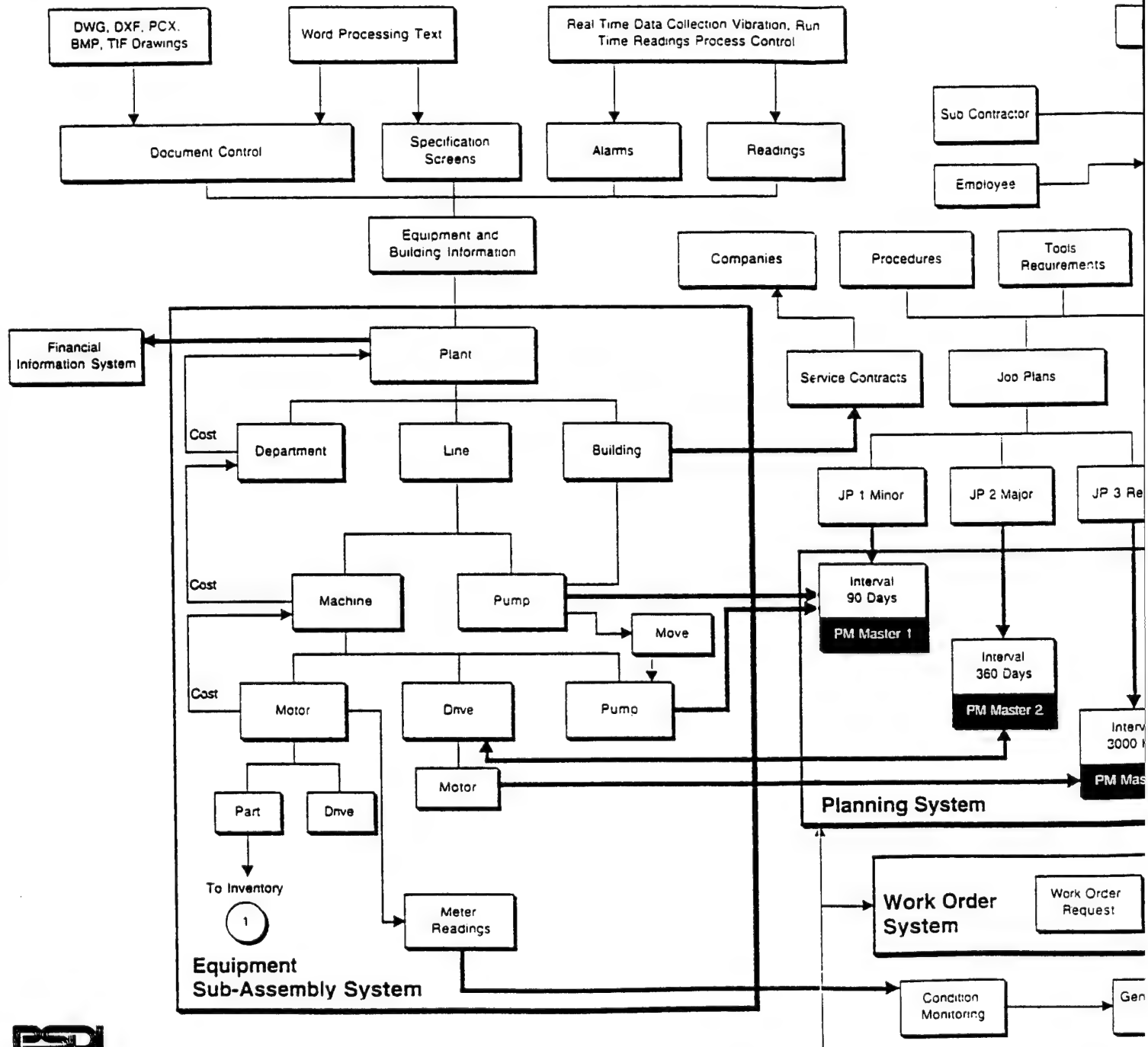
### ***Data Base Organization***

Organizing data generated from multiple maintenance operations is a complex task. The use of the EAS Network based on the Computer-Aided Cost Estimating System (CACES) numbering system makes this task more comprehensible and manageable.

Section B-3 of Appendix B shows the current use of the CACES numbering system by MAMC in an EAS context. This system was devised to provide maintenance management control for approximately 25,000 equipment units in the new Madigan Hospital. The EAS design incorporates the following CACES maintenance topics:

# MAXIMO

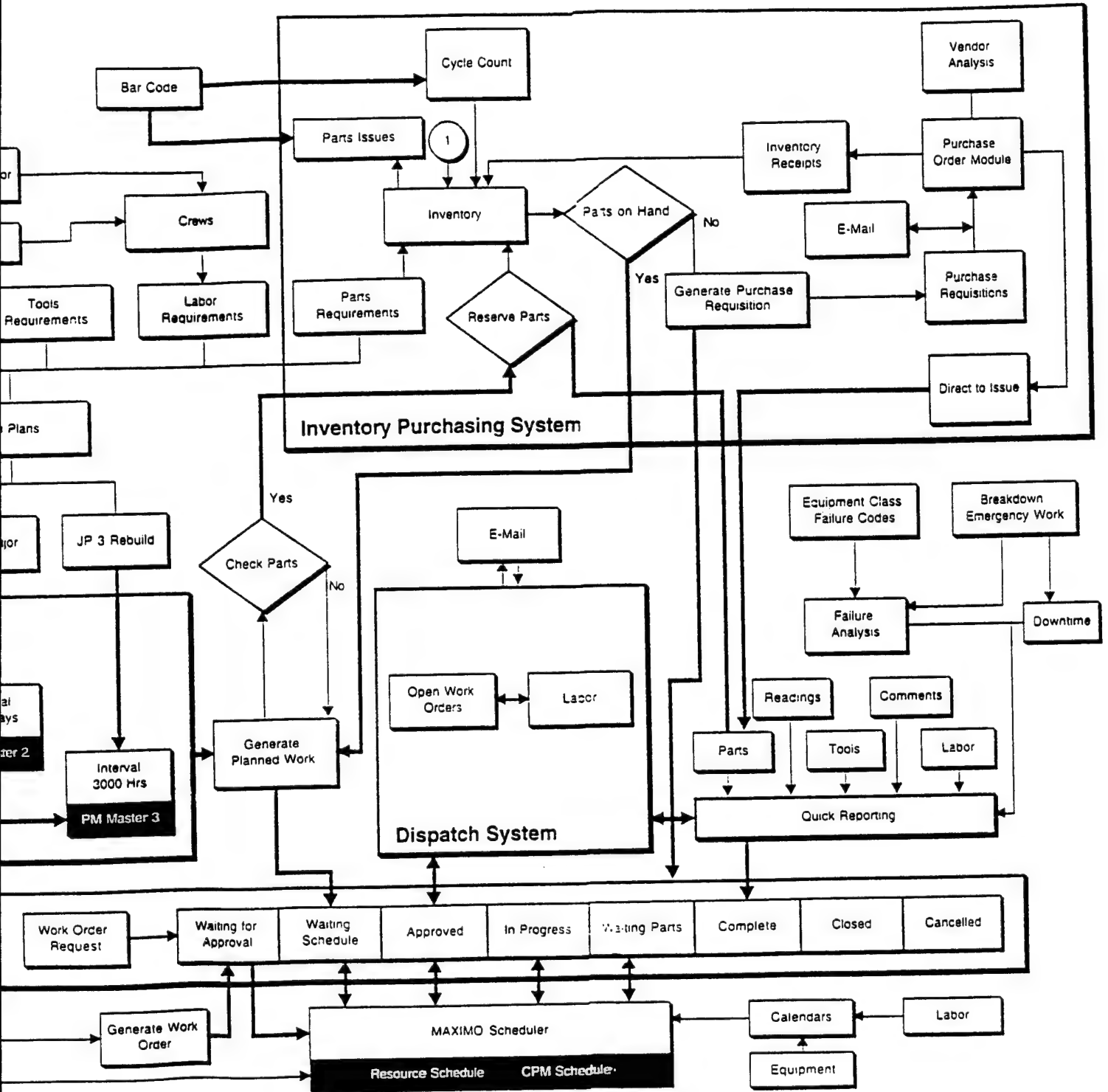
## System Flow Chart



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Figure 1. MAXIMO program system flow chart.

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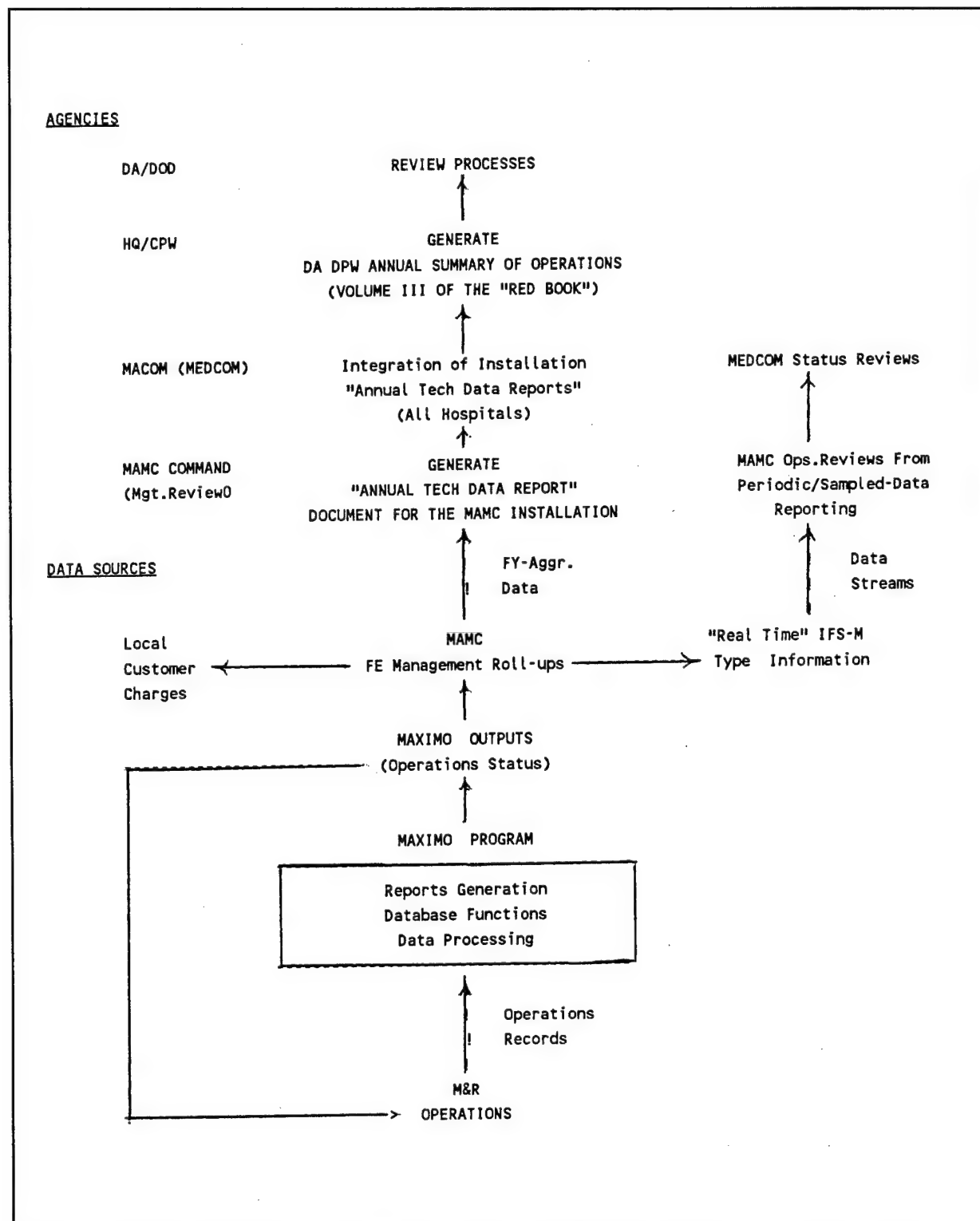


Figure 2. Overall relationship of the MAXIMO program to MAMC M&R operations and upward reporting.

BUILDING ROOF-SYSTEMS	03--	ELECTRICAL SYSTEMS	
EXTERIOR CLOSURES	04--	Exterior HV	None
BUILDING STRUCTURE/HARDWARE	05--	Interior HV	10--
INTERIOR FINISHES	06--	Interior LV	11--
MECHANICAL/HYDRAULIC SYSTEMS			
Utilities	07--		
Plumbing	08--		
HVAC	09--		

### ***The Hopes for an Automated HMMS***

Current circumstances make it desirable to update and generalize the current MAMC/MAXIMO data base. This resultant data base can then be incorporated into an HMMS as part of a MAMC Development Plan for submittal to MEDCOM and formal review by MEDCOM/DA/DOD. A key to ordering and understanding output data in MAXIMO is in the network structures allowed by the program. The reason for organizing the data collection stations into a supertree is that such a structure makes functional "neighbors" readily identifiable so they can be automatically aggregated for cost and engineering analysis or comparison.

### **Assessment of the Equipment Assembly Structure**

The EAS investigations in this study identify the elements in EAS configurations that best support MAMC operational needs and that still meet all of the recognition and processing requirements of the MAXIMO Program. The following discussions outline EAS ciphering/networking techniques developed to meet the needs of the command and operations phases of maintenance operations.

#### ***EAS Number/Label Configurations***

The transparency goal of this project requires that an EAS entry be meaningful to MAXIMO report generation and to management/craftsman interpretation. At the MAMC management and top maintenance management levels, the EAS "number" may be decomposed from an alphabetical source that reflects (identifies) the responsible commands; at maintenance operations levels, alphanumeric adaptations of the CACES numbering system are most informative (Figure 3). (At the operations level, something like the CACES Numbering System now used at MAMC HMMS in a MAXIMO data base context is a well understood and effective approach for the EAS network.) As previously mentioned, the two EAS number/network systems used at MAMC represent a Control and Operations phases. These networks can be further described as:

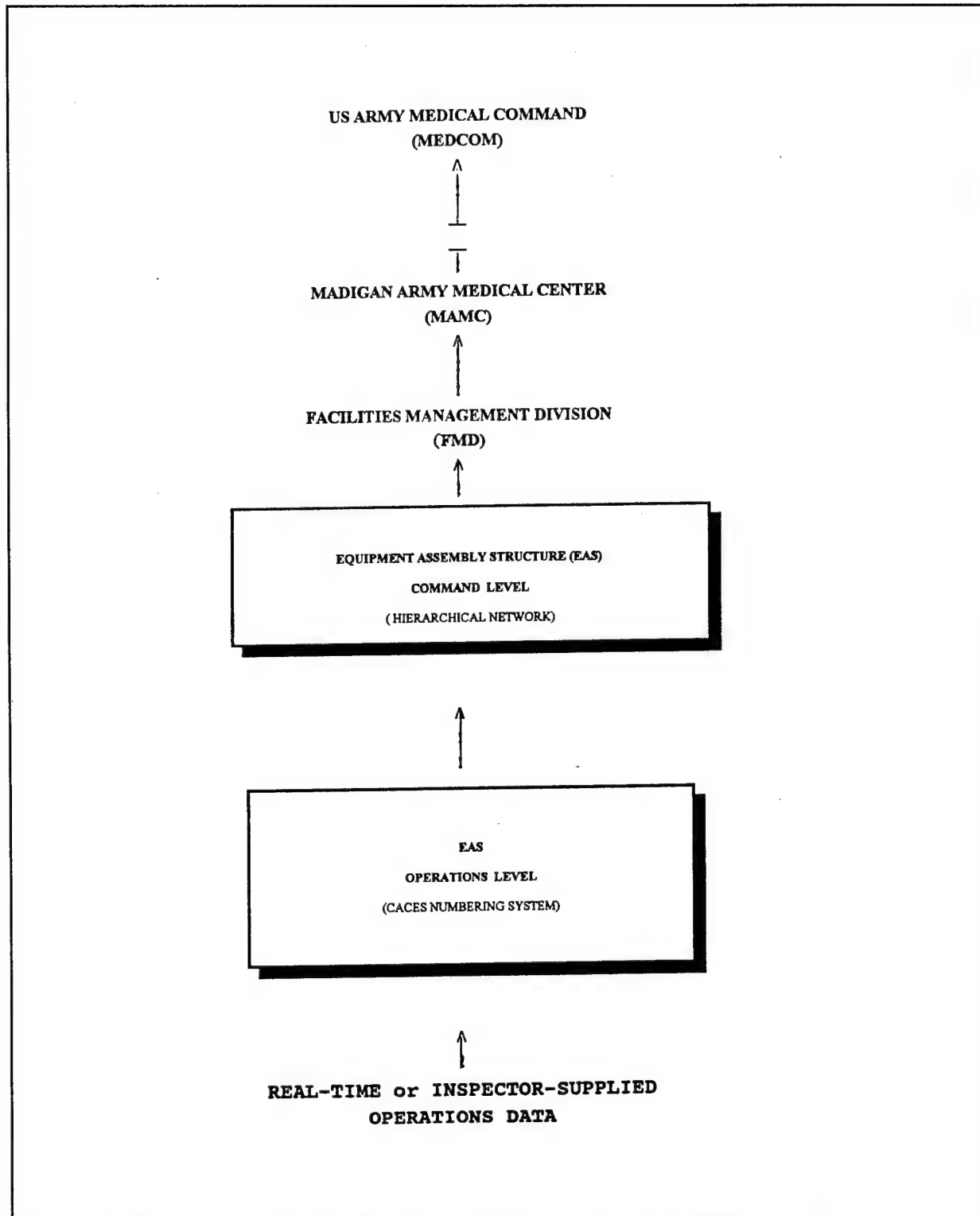


Figure 3. A two-phase EAS approach as used in the MAXIMO data base at MAMC.

1. *Acronym (Alphabetical) Symbols.* Commonly used acronyms for offices or management stations should be standardized and used for upper echelon designations in the MAXIMO data base, and these should also be readily recognized at all medical maintenance areas. Eight (8) spaces are allowed for the EAS number in MAXIMO submittal/review screens; of these, five (5) spaces should be sufficient for the first or upper station designations. These command designations make up Part 1 of the EAS Network or the "Control EAS Phase."
2. *Coded (Alphanumeric) Sequence.* At the maintenance operations levels, the CACES numerical system provides activity/performance/ status designations for classes of systems or specific system/equipment units (Figure 4). Here, the coding may be adjusted to local needs without disrupting the capability for M&R tracking by MEDCOM. This is the main (second) EAS Network, i.e., the "EAS Operations Phase."

Note that the linkages in an EAS Network with two logic patterns (coding methods) are no problem to MAXIMO processing since the predecessor-successor relationship in the MAXIMO data base is an assigned one, and is not dependent on any content of the EAS entry.

### ***EAS Command and Control Phase***

The EAS Command and Control Network of Figure 5 reflects a configuration used in the current MAMC/MAXIMO data base and will be the selected development path for selecting the similar data base activities at all MEDCOM installations. Although still under CERL/MAMC study, this type of network could be developed as a fixed (standardized) format for these installations. Management reporting sequences are identified in this flow from the Commander and subordinate offices down to Zone and System Category responsibility levels.

The MAMC definitions in Appendix A are a basis for developing the command flow structure of Figure 5. Tables A2 and A3 (Appendix A) are the sources of the Zone and Command/Division horizontal line categories of Figure 5. Classes of Systems and the EAS Operations Phase interface are represented in the final two lines, as shown.

A further description of the EAS Designator (EAS Control "Number") development process is provided in Appendix B.

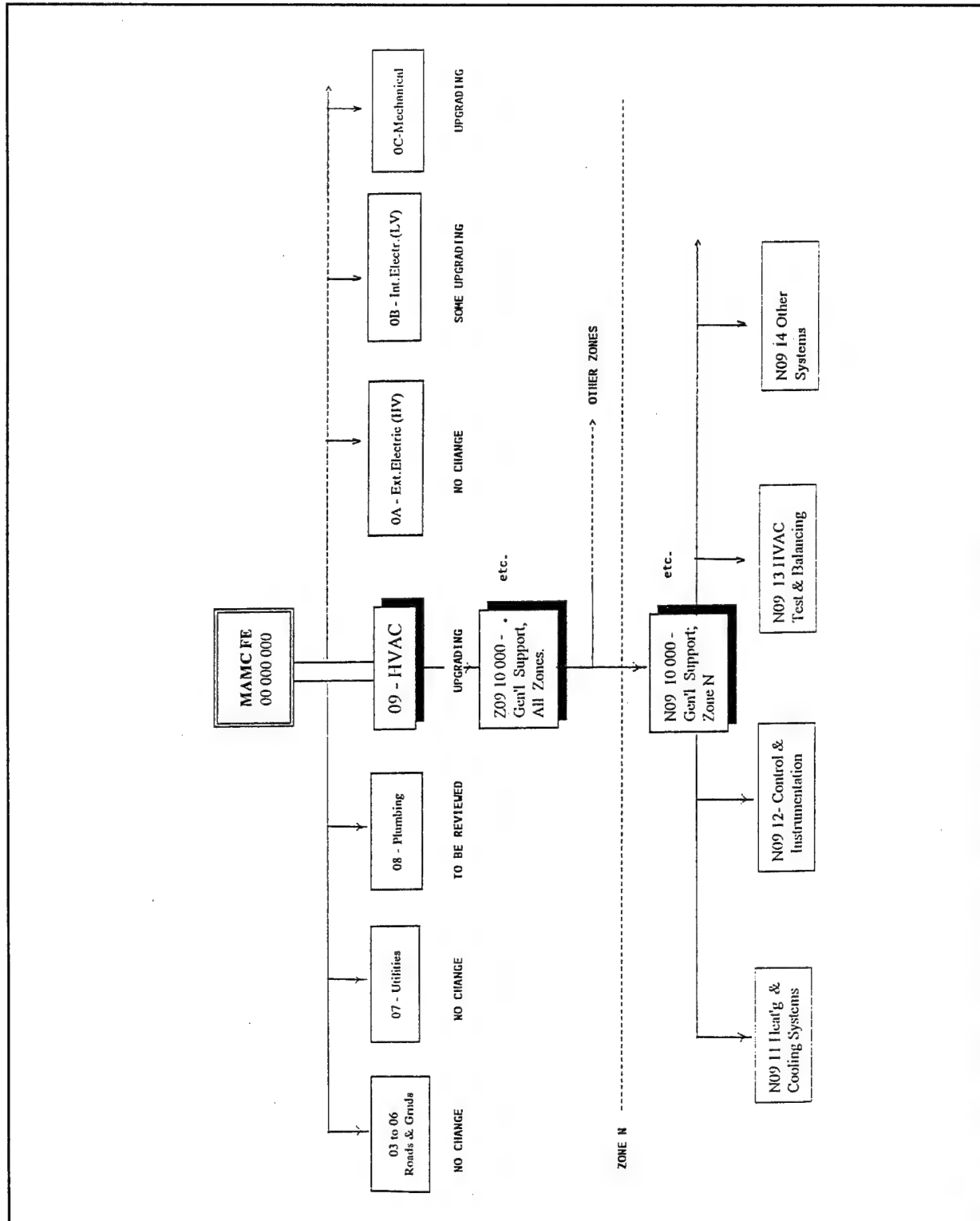


Figure 4. EAS network representation of MAMC facility engineer operations.

# EAS COMMAND AND CONTROL NETWORK

Office of the MAHC Commander

Special Staff Liaison Offices  
MCHJ-CG MCAA-NW MCHJ-DCA/CS

Commands

Vet Services MCVS-NW  
NU Dental Service MDS-NI  
Dep. Cndr. for CI Services MCHJ-CL  
NU Health Services MCHJ-ISSA  
NU Lead Agent MCHJ-NMLA

Divisions

CCD Fac. Maint. Div. F M D  
HRD IN LO OO

Zones

A B C D E -- M N  
New Hospital

Category of Systems

BC BE CS -- -- MD MS Mech Systems

CACES Maintenance Skill Numbers

03 04 05 06 07 08 09 10 11 12 13 14

Buldg. Equip. N040  
Plant Utilities N070  
HVAC N090

E X A M P L E F L O W

Figure 5. Command flow for reports generation by the EAS linkage.

### ***EAS Operations Phase***

The scope of EAS networking possibilities for an operations phase is developed in Appendix B. The EAS information content and network characteristics are:

1. *Information Content:* For the network of Figure B-1 (Attach. B), extensive information is coded into each EAS number. The first entry of the EAS network designates activity or geographical zones (Z); the second entry identifies the shop/skill or overall maintenance category (S). The remaining entries identify the class to specific systems and/or their dimensions down to individual equipment/machine level. Of course, these EAS designations do not actually appear in the data base; they are the "shorthand" used in this report to simplify EAS content discussions.

Briefly, the eight digits of an Operations EAS "Number" for this report will contain selections from the following designators:

Z	Zone	Y	Major Subsystem or Component IDs.
S	Shop/Skill Cat.	N	Specific C or T System & its location.
G	Skill Subcategory	A	Specific maintenance activities applied to System designated (where used) by the above preceding "parent" N.
M	M&R Activity Class	F	Equipment Types included in the or System Category preceding System N.
—		E	Specific Equipment Unit # & EQNUM Table data access.
C	Class of Systems under Category M	—	
T	Type of System under Class C.	P	Specific Parts & Part #s for Equipment E.

For example, the coded EAS Number could be represented in an 8 digit format, for a specific maintenance support area, as:

1 2	3 4 5	6 7 8
Z S	M C T	N F E.

2. *Zones & Performance Activity:* The first two digits of the above EAS Number representation are zones and activities, an approach that is common to all of the concepts or approaches in the operations phase of the network. These two entries can be defined as follows:

$Z = 0$       which indicates NO geographic or functional zones are used

(OR)

which indicates the SUM of ALL zones (for whatever conditions are specified by the rest of the number (i.e., the following six digits of the EAS))

Note that for the initial  $Z = 0$ , there can be no operations (CACES numbered) parent; children can be another  $Z = 0$ , but for multi-zone installations, must eventually contain non-zero valued Zs.

$Z = n$       which identifies a specific geographic or functional zone. Again this zone's parent is initially the  $Z = 0$  roll-up level.

$S = n$       which identifies Skill Class and/or FE Shop for that class. Its parent is the Zone for this branch of the network and its ultimate children are the EAS levels with the same follow-on zero designator for the M&R Class.

Follow-on entries will be as developed in Appendixes B and C.

3. *Exploratory Application.* To explore some of the EAS features previously discussed, the following example applies them to a diverse equipment category, i.e., Heating, Ventilation & Air Conditioning (HVAC) Systems.

HVAC Systems place many system/equipment tracking duties on an automated HMMS—an example of which is the “unpackaged” air conditioning system diagrammed in Figure 6. This figure shows the potential relationship between an EAS numbering approach and Medical Center operations systems and the supporting maintenance activities for these systems. It is also designed as a logical roll-up for a specific EAS configuration; here chosen as:

ZS MYC NEP

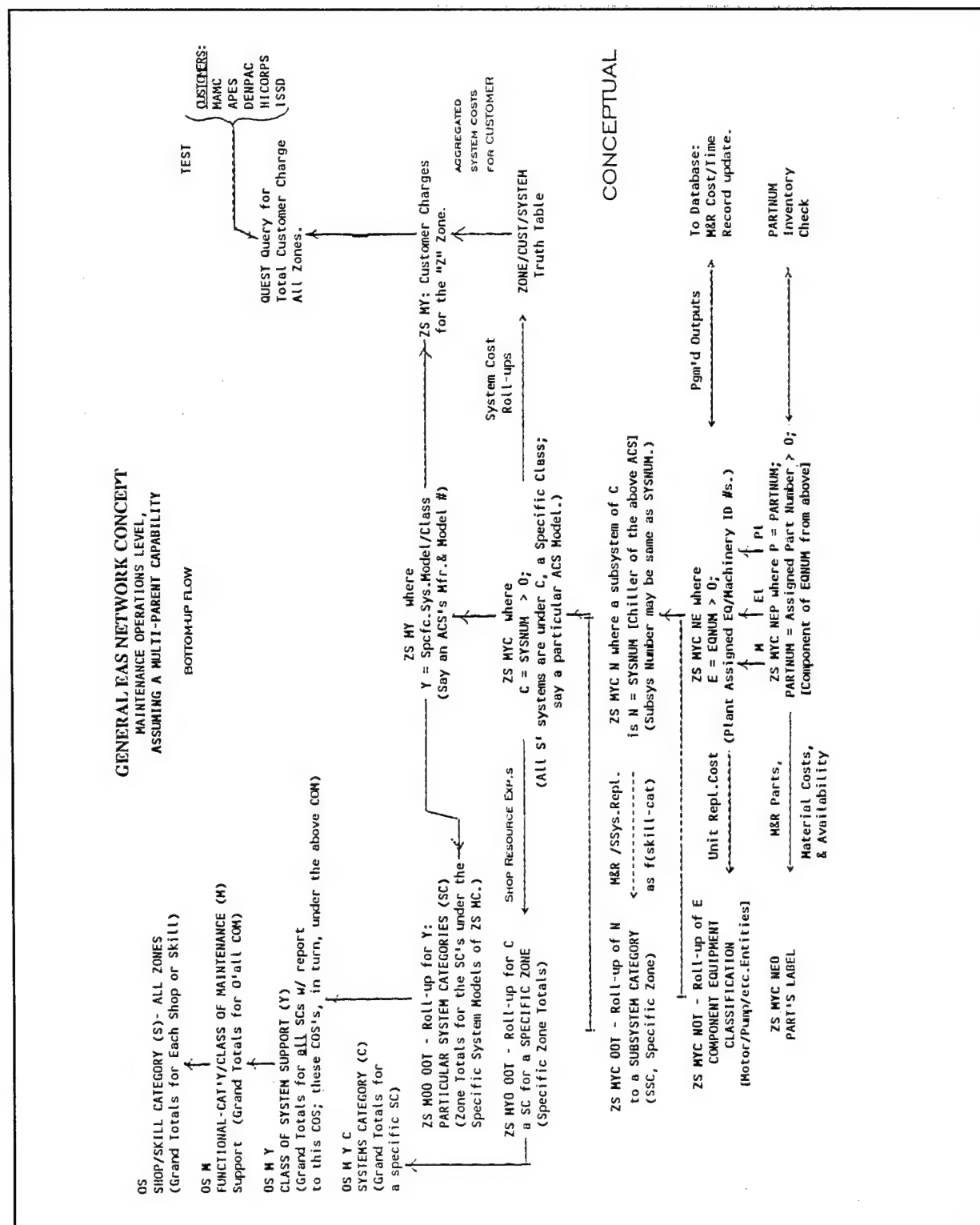


Figure 6. Unconstrained EAS operation network (using unpackaged AC system as the example).

4. *Best-Fit Networks.* Actual best-fit EAS Operation Networks for selected M&R skills/activities are developed in Appendix C from the letter definitions (p 19). Developed EAS entry representations are:

<u>Skills (CACES#)</u>		<u>Example EAS-Number Format</u>
Mech Systems		
Utilities	(07)	ZS - MC - NEP
Plumbing	(08)	ZS - CT - NFE
HVAC	(09)	ZS - MCT - NFE(P)
Electricity		
Internal-HV	(10)	ZS - MCT - NFE
Internal-LV	(11)	ZS - MCT - NFE

## Overview

The Operations Portion of the EAS Network uses a CACES-coded numbering system. In Figure 6, the EAS Number is "coded" to "ZS MYC NEP" as an illustrative convenience. This EAS Network configuration can change with different installations and with each "S" (Shop/Skill-Class), according to the needs of local maintenance operations. Similarly, "T" totalizing activities are not mandated, but are used wherever an operations cost aggregation level is desired for that shop or activity.

### 3 EAS Network and Program Performance

The EAS Network is a "reference" by which maintenance resources, activities, and equipment are matched into an integrated statement by the MAXIMO Program. The EAS network is likewise a useful tool in setting up a particular data base for specific applications. This chapter summarizes the control and operations phases of the EAS Network in the MAMC/MAXIMO data base most applicable to generalized HMMS planning using the existing EAS configuration and some site-adaptable alternatives for the operations EAS.

#### The Total EAS Network

The Command and Operation Phases are represented by two EAS network configurations for a Control EAS Network (Figure 7) and for an Operations EAS Network (Figure 8). The ordering of the EAS entities in the network is by rank in the Command Phase of Figure 7, and numerically in the Operations Phase of Figure 8. Management (control) submittal levels are identified in Figure 7 from the Commander and subordinate offices to Zone and System Category responsibility levels. The formatting approach of the Operations EAS Network in Figure 8, however, places system/activity ownership in an EAS numerical sequence.

It is planned that HMMS users will conform to provided Command EAS Network standards, but will adapt Operations EAS Network guidance to their local needs. The ordering by MAMC Command of the first EAS Network (Figure 8) derives from the MAMC Organization of Table A3 (Appendix A). This ordering shows that Operations EAS Network designations can be stated in field maintenance terminology, so that the CACES numbering model may be followed completely or partially, allowing for operations-familiar, in-plant labeling when this best facilitates the process.

GENERAL EAS COMMAND NETWORK  
(Temporarily using MAMC designations)

UPPER MAINTENANCE MANAGEMENT'S  
EAS CONTROL PHASE NETWORK

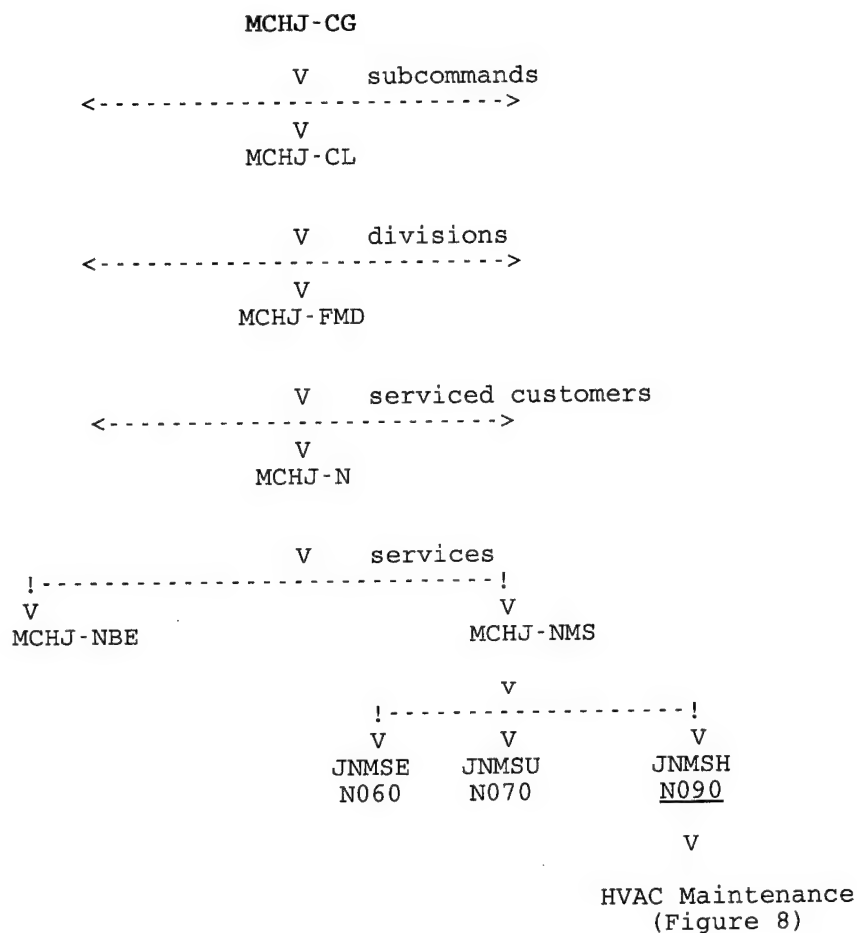


Figure 7. Rank ordering of the EAS control network for the command level.

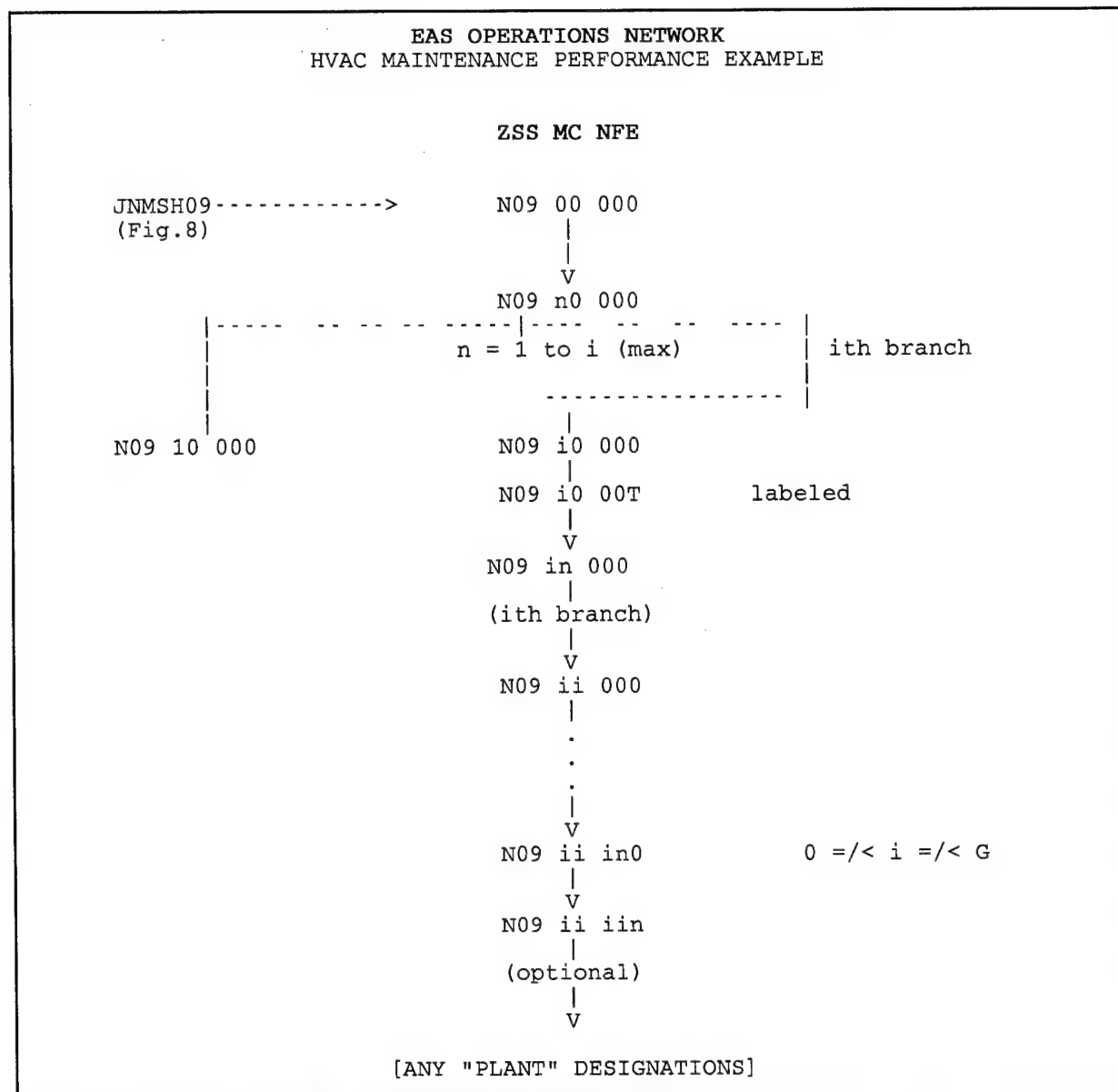


Figure 8. Numerical ordering of the EAS operations network.

## Potential Variables

The EAS Operations Designators can accommodate a customizing of the HMMS data base with locally needed variables or features. Take, for instance, numbering levels at or above specific equipment designations (E); special labels can be placed in the "E" position; e.g., the EAS number with a location label "09 111 10L." Typically, labels will indicate aggregated cost (T), customer charges (R), location identification (L), associated contracts (K), etc. These letters create a dummy EAS number in the EAS Network, which can be queried by MAXIMO without disrupting the EAS numbering logic.

## Example Run-Through of the MAMC EAS Operations Network for HVAC Activities

Basic and numerical EAS developments can be illustrated by a Heating, Ventilation and Air Conditioning (HVAC) application. The basic premise of the system is to restrict the HVAC EAS to a simple Skill/Class/System/ Subsystem/Equipment hierarchy, all adapted to total/ zone/customer roll-ups. For actual operations use, apply specific maintenance activity labor and equipment charges (L&E inputs) to proper levels as attribute records at these levels. The EAS entry representations is:

ZS-MCT-NFE:

which denotes:

ZS	MCT	NFE
Zones/Skills	Categories/Classes of Systems/Types of Systems	Subsystem ID/ Equipment Types/Specific Equipment Description and Unit No.

Table 1 lists single and multiple zone MAMC EAS numerical sequences and Table 2 lists associated equipment/system plant designations. Here, the above plan is followed at MAMC up to the 6th letter (tier) "N," where the option exists for either continuing with CACES-type numbers or switching to industrial or local type procedural identifications that are more meaningful to maintenance and repair (M&R) field workers and their supervisors. Application III (Appendix C) gives a good example of the application of Table 1 methods.

Table 1. Current MAMC EAS operations network.

**GENERAL**

TO ILLUSTRATE, THE EAS NUMBER CONTAINING THE ROLL-UP OF MAINTENANCE ACTIVITIES AT MAMC FOR A TOTAL HVAC OPERATION IS:

09 000 000 HVAC Maintenance, Mechanical; Mech HVAC Totals.

**SINGLE ZONE INSTALLATION:**

<b>FIRST TIER</b>	<b>TOTAL INSTALLATION</b>	<b>(Z=0)</b>
0	Z = 0:	Provides Total Maintenance Recorded Costs or Hours for all Shops and Skills.
<b>SECOND TIER</b>	<b>SHOP/SKILL DESIGNATIONS</b>	<b>(S=n)</b>
09	Z = 0; S = 9: or SS = 09:	Provides Total Maintenance Recorded Costs or Hours for a specific Shop/Skill (HVAC).
<b>THIRD TIER</b>	<b>MAINTENANCE ACTIVITY CATEGORY</b>	<b>(M=n)</b>
09 1	HVAC, General Support	
09 2	Heating Systems	
09 3	Ventilation & Forced Draft Systems	
09 4	Cooling Generation Systems	
09 5	Air Conditioning Systems, Packaged	
09 6	AC Systems, Non-packaged	
<b>FOURTH TIER</b>	<b>CLASS OF SYSTEM</b>	<b>(C=n)</b>
09 100	HVAC, General Support (M = 1)	
09 1n0	Class of Systems (C = n)	
09 110	Heating & Cooling Systems	
09 120	Controls & Instrumentation	
09 130	HVAC Testing & Balancing	
09 140	Others	
09 200	Heating Systems	
09 210	Heat Energy Sources	
09 220	Furnaces	
09 230	Spare	
09 300	Vent & FD Systems, etc.	
09 400	Cooling Generation Systems	
09 410	Simple Refrigerant Systems	
09 420	Chillers	
09 430	Heat Rejection Systems	
09 440	Others	
09 500	Air Conditioning (Packaged) Systems, All Zones	
09 510	Window Systems	
09 520	Low Volume(Local Area Control) Systems	
09 530	High Volume (Building Control) Systems	
09 600	AC Systems, Unpackaged	
09 610	AC System, Unp - Type # 1	
09 620	AC System, Unp - Type # 2	
	etc.	

FUNCTIONAL CONTINU- ANCE (Of EAS Numbering System)	This Point Can Include an EAS NETWORK OPTION (OR)	A DESIGNATION SWITCH (Set EAS = to Plant No.s) SEE TABLE 2
continuing V		
<b>FIFTH TIER</b>	<b>SPECIFIC TYPES OF SYSTEMS</b>	<b>(T)</b>
09 610	AC System, Unp (ACN) - Type # 1	
09 61n	List of Specific ACN Units (Type 1),	
09 611	ACN Unit #1.	
<b>SIXTH TIER</b>	<b>MAJOR SUBSYSTEMS OR COMPONENTS</b>	<b>(Y&amp;N)</b>
09 611 n00	Subsystem n of ACN # 1	
09 611 100	Piping System for Chillers.	
09 611 200	Chiller # 1	
09 611 300	Chiller # 2.	
etc.		
<b>SEVENTH TIER</b>	<b>SPECIFIC SUBSYSTEM EQUIPMENT TYPES</b>	<b>(F)</b>
09 611 2n0	Chiller # 1 Components	
09 611 210	Component # 1 OF Chiller # 1 (say this is Pump #1 for Chiller # 1 of ACN Unit # 1).	
<b>EIGHTH TIER</b>	<b>SPECIFIC EQUIPMENT OR MACHINERY</b>	<b>(E)</b>
09 611 21n	Machinery Components of Pump # 1.	
09 611 211	Say the Motor of Pump # 1; here, Motor Unit inven- tory number and description is supplied.	
<b>MULTIPLE ZONE INSTALLATION:</b>		
<b>FOR Z = 0:</b>		
Installation-wide summaries for multiple zone bases are usually not needed past the third or fourth tier as shown for the Single Zone Installation above.		
<b>FOR Z = A:</b>		
(Illustration using Zone A as an example.)		
<b>FIRST &amp; SECOND TIER</b>	<b>TOTAL CHARGES FOR AN INDIVIDUAL ZONE AND A SPECIFIC SHOP</b>	<b>(Z=n) (S=n)</b>
nn'	Z = n; S = n' Indicates entry is as in Single Zone	for Zone n (n = 1 to G) and Shop n' (n' = 1 to D).
A9	Case	Provides Total Maintenance Recorded Costs or Hours for Zone A and the HVAC Shop.
Z = A; S = 9:		
<b>THIRD TIER</b>	<b>OVERALL CLASS OF MAINTENANCE ACTIVITY</b>	<b>(M=n)</b>
A9 1	HVAC, General Support	
A9 2	Heating Systems	
A9 3	Ventilation & Forced Draft Systems	
A9 4	Cooling Generation Systems	
A9 5	Air Conditioning Systems, Packaged	
A9 6	AC Systems, Non-packaged	
A9 7	[Spare]	

<b>FOURTH TIER</b>	<b>CLASS OF SYSTEM</b>	<b>(C)</b>
A9 100	HVAC, General Support, Zone A	
A9 110	Heating & Cooling Systems	
A9 120	Controls & Instrumentation	
A9 130	HVAC Testing & Balancing	
A9 140	Others	
A9 150	Spare	
etc.		
A9 600	AC Systems, Unpackaged	
A9 610	AC System, Unit # 1	
A9 620	AC System, Unit # 2	
etc.		
<b>FIFTH TIER</b>	<b>SPECIFIC TYPES OF SYSTEMS</b>	<b>(T)</b>
A9 610	AC System, Unit # 1	
A9 611	Component # 1 (Chiller # 1)	
<b>SIXTH TIER</b>	<b>MAJOR SUBSYSTEMS OR COMPONENTS</b>	<b>(Y&amp;N)</b>
09 611 n00	Subsystem n of ACN # 1	
A9 611 200	Chiller Component # 2 (Pump # 1)	
<b>SEVENTH TIER</b>	<b>MACHINERY/EQUIPMENT TYPES</b>	<b>(F)</b>
09 611 2n0	Machinery Components of Pump # 1.	
A9 611 210	Pump Component # 1 (Motor)	
<b>EIGHTH TIER</b>	<b>SPECIFIC EQUIPMENT OR MACHINERY</b>	<b>(E)</b>
A9 611 210	Pump Component # 1 (Motor)	
09 611 21n	Machinery Components of Pump # 1.	
09 611 211	Say the Motor of Pump # 1; here, Motor Unit inventory number and description is supplied.	
<b>NINTH TIER (?) - PARTS IDENTIFICATION</b>	<b>(P)</b>	
A9 611 110	Pump Component Classifications	
A9 611 111	Motor Drive Identification	
A9 611 112	Impellar & housing Identification	

Table 2. Example MAMC equipment/system plant designations.

HVAC SYSTEMS, AIR HANDLING UNITS (AHUs)			
EAS #	EQUIP #	DESCR BLDG-AREA	ACQUISITION DATE
09A 11 100	<b>AHUs 6500 CFM</b>		
	AHU-092:	CVVT, M00001-G-97	01/90
	AHU-100	CVVT, M00001-C-n	12/88
	to 105:	CVVT, M00001-3-4	12/87
09A 11 200	<b>AHUs 10,000 CFM</b>		
	AHU-20:	CVVT, M00001-P-304	01/90
	AHU-27:	CVVT, M00001-G-701	01/90
	AHU-47:	CVVT, M00001-1-701	12/85
	AHU-94		
	to 97:	CVVT, M00001-1-n	12/85
	AHU-98	CVVT, M00001-C-3	12/88
	AHU-99	CVVT, M00001-C-6	12/88
09A 12 100	<b>Dual Duct AHUs - 6500 CFM</b>		
	AHU-14:	CVDD, M00001-G-401	12/89
09A 12 200	<b>Dual Duct AHUs 10,000 CFM</b>		
	AHU-37:	CVDD, M00001-1-318	12/85
	AHU-41:	CVDD, M00001-G-315	12/89
	AHU-67:	CVDD, M00001-2-228	12/86
09A 12 300	<b>Dual Duct AHUs - 25,000 CFM</b>		
	AHU-09		
	to 11:	CVDD, M00001-G-n	01/90
	AHU-15,		
	16 & 18:	CVDD, M00001-G-n	12/89
	AHU-44		
	& 45:	CVDD, M00001-G-n	12/85;89
	AHU-56A		
	& 63:	CVDD, M00001-2-n	12/86
	AHU-74		
	to 85:	CVDD, M00001-m-n	12/88

## Operations EAS Configuration Alternatives

Once an EAS Operations configuration is chosen, installed, tested, and brought on line, the configuration is fixed for that organization until subsequent change requests are authorized by MEDCOM. The flexibility described here is designed into the data base so it can be tailored to meet various local medical center (LMC) needs, but still maintained in a standard form for MEDCOM's use.

## Allowable Operations EAS

Alternative EAS Network configurations are now provided that illustrate what is available to meet LMC maintenance needs—at the time of software installation/implementation. Table 3 indicates the choice of EAS Network approaches that may be incorporated into the MAXIMO procedure for any particular Army Medical Center at data base setup time. (Interpretation of the Operations EAS entries shown in Table 3 depends on referencing EAS letter “designators” (p 19).

Since each of the maintenance categories in the CACES System follows a pattern in its procedural approach, an EAS Network Configuration may be represented by a “Generalized Designator Series” for the EAS Number of each maintenance category. Table 3 lists “EAS Designators” in both a basic and alternative form. This limited option permits a delivered automated HMMS product in an easy-to-maintain standardized form, but also with application functions variable enough to meet individual installation’s needs and to create customized roll-up and summary reports.

**Table 3. Permissible EAS network configurations at the maintenance operations level.**

CACES Description	EAS Designators			
	(S#'s)	Basic EAS Rep.	Altern.Single Zone EAS	Altern.Multi-Zone EAS
BUILDINGS:				
ROOFING	(03)	ZSS GM CN0	0S GMC N00	ZS GMC N00
EXT.CLOSURE	(04)	ZSS MC NF0	0S MCN F0L	ZS GMC N0L
INT.CLOSURE	(05)	ZSS GM CN0	0S GMC N0L	ZS GMC N0L
FINISHES	(06)	ZSS GM CN0	0S GMC NOL	ZS GMC N0L
UTILITIES	(07)	ZSS GM CNE	0S GMC NEO	ZS GMC NEP
INT.PLUMBING	(08)	ZSS MC TNE	0S MCT NFE	ZS MCT NEP
HT, VENT & AC	(09)	ZSS GM CNF	0S GMC NFE	ZS GMC NFE (or) ZS MCT YFE
ELECTRICAL:				
EXT.EL.- HV	(10)	External electrical systems are not currently monitored for HV.		
INT.EL.- HV	(10)	ZSS MC TN0	SS MCT NFE	ZS MCT NFE
INT.EL.- LV	(11)	ZSS MC TN0	SS MCT NFE	ZS MCT NFE
SPCL.SYSTEMS [Communications]	(12)	ZSS GM TH0	SS GMT H00	ZS MCT YNE
CONVEYANCES	(13)	ZSS GM 000	SS GM0 TNE	ZS MCT YNE

## 4 Conclusions and Recommendations

### Conclusions

This initial stage of research has reviewed the MAMC/MAXIMO data base currently in use at Madigan Army Medical Center and verified its potential effectiveness for general Army medical facilities use. This study concludes that, with limited adjustments, the MAMC/MAXIMO data base may be "upgraded" to an optimal level for general use in Army medical centers, hospitals, and clinics.

This study also found that a re-engineering of the EAS is a key element to achieve effective MAXIMO Program processing, efficient user interfaces, and refined report/printout generations. The use of the EAS Network based on the CACES numbering system makes this task more comprehensible and manageable. Table 3 (p 31) identifies EAS Operator Network configurations suitable for the MAMC/MAXIMO data base.

With the approach recommended in this report, HMMS users may conform to Command EAS Network standards, while adapting Operations EAS Network guidance to their local needs. The flexibility described here will be designed into the data base so it can be tailored to meet various local medical center needs, but can still serve MEDCOM as a software standard. By combining CACES and plant designations (Chapter 3), there will be no installation machinery/system representation that cannot be met.

A finalization of this study will determine if these results may be better integrated and/or optimized in any way. It is also concluded that:

1. The assumptions for this study are valid and should be accepted as stated.
2. From functional software studies, the MAXIMO Platform is sufficient and adequate to support the data base refinements planned.
3. For any particular MEDCOM installation, uniformity in operations between maintenance shops (or skill areas) is not found in practice, and should not unnecessarily constrain data base or procedural developments.

**Recommendations:**

1. Appropriate training and documentation should be provided to keep Medical Center implementations within HMMS/MAXIMO data base tolerances that allow and ensure acceptable IFS-M and MEDCOM interfaces.
2. This report and follow-on reports and documentation should be coordinated to:
  - a. Generate a CERL/MAMC Data Base Development Plan (DDP) and coordinate this plan with MEDCOM; upgrade the DDP to satisfy coordinated/ approved Plan changes
  - b. Verify compatibility of DDP with total HMMS planning
  - c. Set up the next coordination phase with the Walter Reed or Brooke (Fort Sam Houston) Medical Centers, and the Reynolds Army Hospital (Fort Sill).
3. This project should continue to develop by this sequence:
  - a. Upgrade the DDP into a first-cut of the "Final Plan" (DDP-Alpha)
  - b. Generate DDP-Alpha software; test DDP-Alpha at MAMC DPW
  - d. Modify SW & Plan according to Lessons Learned and MMS integration studies; plan DDP-Beta test phase
  - e. Coordinate/test DDP-Beta at a selected medical center and Army hospital; document and distribute the Final DDP.

## Appendix A: MEDCOM/MAMC Organizational Features

The relationship of MEDCOM to MAMC and MAMC to Center activities should be understood. The MEDCOM/MAMC Command Structure, and MAMC HMMS areas of responsibility (and duties performed) are basic to this understanding. This relationship impacts the 27 Hospitals, 9 Medical Centers, and 469 Clinics now under MEDCOM supervision. Table A1 lists the affected Army Hospitals and Medical Centers.

**Table A1. Impacted Army hospitals and medical centers under MEDCOM supervision.**

Hospital	Location	Medical Center	Location
Bayne-Jones	Fort Polk, LA	William Beaumont	Fort Bliss, TX
Basset	Fort Wainwright	Brooke	Fort Sam Houston, TX
Raymond Bliss	Fort Huachuca, TX	D.D. Eisenhower	Fort Gordon, GA
Darnall	Fort Hood, TX	Fitzsimmons	Aurora, CO
DeWitt	Fort Bliss, TX	Madigan	Fort Lewis, WA
Evans	Fort Carson, CO	Walter Reed	Washington, DC
Fox	Redstone Arsenal, AL	Womak	Fort Bragg, NC
Ireland	Fort Knox, KY	Tripler	Oahu, HI
Irwin	Fort Riley, KS	Landstuhl Regional	Germany
Kenner*	Fort Lee, VA		
Kimbrough	Fort Meade, MD		
Lyster	Fort Rucker, AL		
Martin	Fort Bliss, TX		
McDonald	Fort Eustis, VA		
Moncrief	Fort Jackson, SC		
Munson	Fort Lee, VA		
Nobel	Fort McClellan, AL		
Patterson	Fort Monmouth, NJ		
GEN L. Wood	Fort Leonard Wood, MO		
Reynolds	Fort Sill, OK		
Weed	Fort Irwin, CA		
Wilcox	Fort Drum, NY		
William Kellar	West Point, NY		
Winn	Fort Stewart, GA		
* To be downsized to an Army Clinic in FY97.			

Figure A1 shows the MEDCOM command structure, its subcommands/offices, and medical labs and clinics.

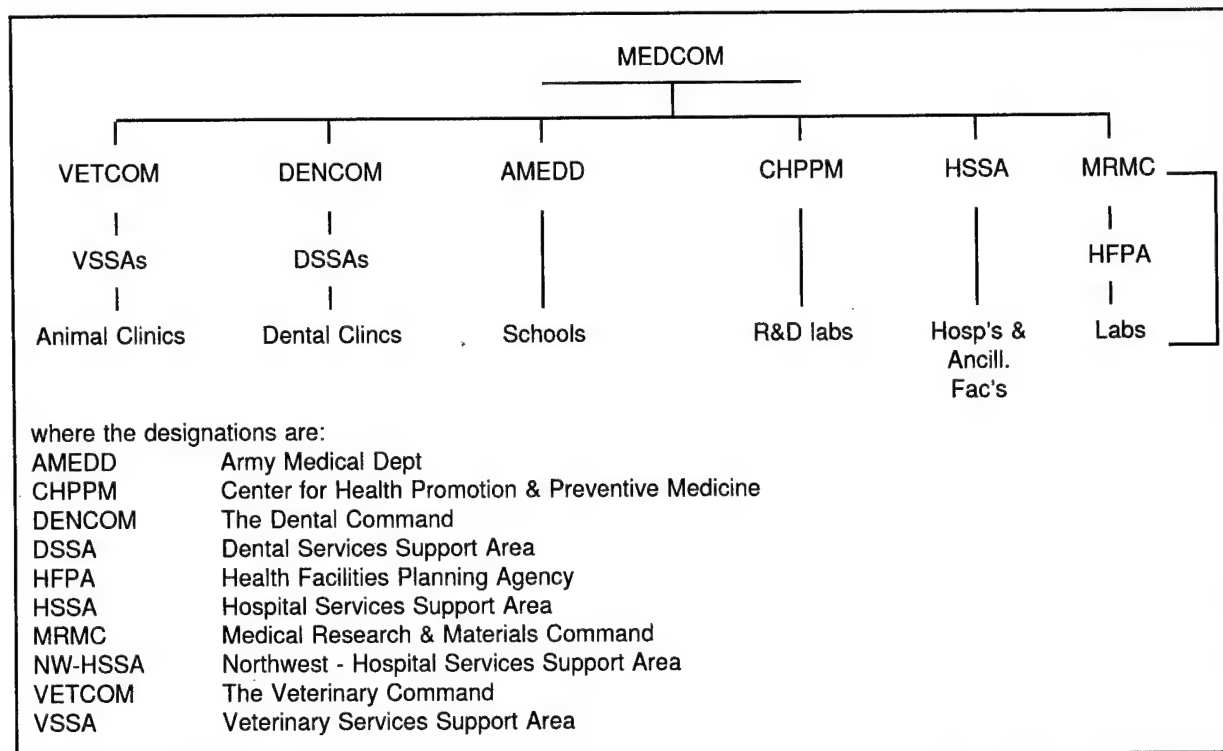


Figure A1. MEDCOM command structure network.

Facility reports submitted to these entities should use the 5 Digit Construction Category Codes (CC) from the DA Facility Classes and Construction Categories (AR and DA PAM 415-28). These CC codes are recognized by IFS-M, and are in the vocabulary of MEDCOM personnel for identifying medical facility types:

First Digit: The defining first digit is identified as follows:

- 10000 Operational & Training Facilities
- 20000 Maintenance & Production Facilities
- 30000 Research, Development, Test, and Evaluation Facilities
- 40000 Supply Facilities
- 50000 Hospital & Medical Facilities
- 60000 Administrative Facilities
- 70000 Housing & Community Facilities
- 80000 Utilities & Ground Improvements
- 90000 Real Estate

Second Digit: Identifies the Category Group

- 510 00 Medical Centers/Hospitals
- 530 00 Laboratories

Third Digit: Identifies the Facility Sub-Group, defined by DOD

510 10 Hospital

510 20 Hospital Clinic

According to MEDCOM personnel several identifiers have been added to this coding:

Fourth & Fifth Digit: Identifies a specific item within the basic category, a level of reporting required by the Army.

Sixth & Seventh Digits: These are OPTIONAL MACOM expansions of the HQDA five-digit Real Property Category Codes. Units of measure must correspond to those of the five-digit category codes.

## MAMC

Table A2 lists the labels for MAMC designated zones/areas. Table A3 lists the MAMC command structure, and Figure A2 shows a matrix of zones versus FMD support services.

**Table A2. MAMC-FMD maintenance support areas/zones.**

HA	Ambulance & helicopter
HC	Troop medical clinic
HF	Fuel oil Rx & handling
HI	Clinical investigations
HM	Emergency power (old MAMC)
HB	Backup SA's service areas (SAs)
HD	Dental clinics (TMC)
HG	Grounds, parking lots & facilities roads, & external structures
HL	Street & Grounds lighting
HN	NEW MAMC hospital & clinic facilities

**Table A3. Madigan Army Medical Center (MAMC) organizational structure.**

Office of the Commander, MAMC	MCHJ-CG
Deputy Commander for Clinical Services	MCHJ-CL
Chief of Staff/Deputy Commander for Administration	MCHJ-DCA/CS
Northwest Support Area (SA):	
Lead Agent	MCHJ-NWLA
Contracting Center	MCAA-NW
Health Service SA	MCHJ-HSSA
Dental Service SA	MCDS-NI
Veterinary Service SA	M CVS-NWV
Divisions:	
Coordinated Care	MCHJ-CCD
Facilities Management	MCHJ-FMD
Human Resources	MCHJ-HRD
Information Management	MCHJ-IM
Logistics	MCHJ-LO
Nutrition Care	MCHJ-NC

**Table A4. Distribution of FMD maintenance services across MAMC functional zones.**

Areas	Building Composition	Building Equipment	Communication/Security	Electrical—Internal	Electrical—External	Fire Protection	Medical Support	Mechanical Systems	Environment	External Structures	Paved Surfaces	Others
Zone	BC	BE	CS	EL	EX	FP	MD	MS	NV	ST	PS	OO
HA	x	x	x	x	x	x	-	x	—	—	—	—
HC	x	x	x	x	—	x	x	x	—	—	—	—
HD	x	x	x	x	—	x	x	x	x	—	—	—
HF	x	x	—	—	—	—	—	x	—	—	—	—
HG	x	x	—		x	x	—	x	—	x	x	x
HI	x	x	x	x	—	x	x	x	x	—	—	—
HM	—	—	—	—	x	—	—	—	—	—	—	—
HN	x	x	x	x	x	x	x	x	x	—	—	—

x = indicated FMD maintenance support (column) is supplied to the designated zones (rows).

## Appendix B: Equipment Assembly Structure (EAS) Functional Considerations

### B-1: EAS NUMERICAL DEFINITIONS

For the alternate (improved) network concept of Figure 4 (Page 17), the EAS numbering contains ciphered data that are decoded by the following information.

#### Organizational Relationships

**First Entry (Z).** For Entry 1, a Zone (Z) designation is required:

Z = 0: Indicates NO geographic or functional zones are used;  
(OR)  
Indicates the SUM of ALL zones in the EAS.

Z = n: Identifies a specific geographic or functional zone,  
where "n" is a positive number.

**Second Entry (S).** The second entry is reserved for the skill/shop (S) area designation. There may be 15 possible numerical S values here to be specified by a one digit entry. Hence, a Hexadecimal Counting System is required, viz: n = 1 to F (where F = 15).

For example, Attachment B: Applications IV (Page 28) shows that for an EAS Number of "0B 000 000" the "B" would be 11 in our decimal system and would stand for a CACES designation of "The Maintenance of Interior Electrical Systems" (under 600 Volts).

#### **Skill Area or Class of System**

**Third Entry (M).** A SYSTEM CATEGORY designator—the overall functional categories served by the particular Shop from the Second entry are totaled in this data section (for all contributing zones if Z = 0).

**Fourth Entry (C).** The CLASS of SYSTEM (COS) can be identified here; also the number and type of subsystems will be designated (usually from locally assigned Plant Numbers).

**Fifth Entry (T).** The Specific TYPE of SYSTEM is identified by the fifth entry (from a choice of system types for the C class). The EAS turns from a general activity to specific maintenance area at this point. Hence, data files, queries, and other support may be called in here or by subsequent entries.

#### **Designation/Identification of Specific Equipment**

**Sixth Entry (Y).** Identifies a SPECIFIC SYSTEM by plant or DPW assigned system-number; each numbered data set has a list of associated major subsystems.

**Seventh Entry (N).** Identifies a SPECIFIC SUBSYSTEM from the Y selection; each such subsystem has a list of associated equipment or connection systems with their assigned numbers. Also designates equipment classification (name such as motor, pump, etc.) and type, by size, features, and manufacturer; where  $T(n) = 1$  to G.

**Eighth Entry (E).** Identifies SPECIFIC EQUIPMENT UNIT by DPW or Plant Number, serial number, and work history; the parts list is callable from an EQNUM Table in MAXIMO.

Hence, the formatted EAS Number is:

Z S M C T Y N E.

## B-2: EAS NETWORK OPERATIONS-LEVEL ALTERNATIVES

Column 1 of Figure B1 outlines the in-place (current) MAMC MMS for HVAC procedures in an EAS Network form, but using a "streamlined" EAS numbering system. Also under each maintenance class/shop activity box, the EAS revision intentions by this study are indicated.

Column 2 of Figure B1 provides conceptual EAS networks laid over the current MAMC MMS MAXIMO database. On the left, an advance in the EAS numbering system is shown while keeping the current network logic. On the right of the Figure B-2 graph is an alternative (improved) EAS Network for representing mechanical systems. This improved EAS configuration allows:

- mechanical systems structure logic
- clear time & materials roll-up charging
- direct customer-charge pull-outs.

The Example Alternative EAS network shows all nonpackaged air conditioning systems (AN-N) under control of an HVAC Shop and the maintenance and repair (M&R) record stations for each system class/type and its successor component listings. Note that the Year-to-Date, monthly, or weekly charges (resources, downtime or other costs) at all or a portion of these AC-N levels may be obtained from (automated) reports or requested printouts that are generated from a search for EAS numbers with an imbedded "T" (for totals).

Such a "T" entry is within network logic and EAS numerical sequencing. It is easily identified visually and by PC logic. Note the "T" entry contains essential charge summations, whereas its parent contains status and descriptive text information.

### B-3 EAS Operations Network: MAMC Use of CACES Numbering in EAS Designations

HN New Hospital/Clinic Facilities  
 HNBC Building Components

#### N03 00 000 BUILDING ROOF-SYSTEMS

N03 10 000 ROOFING  
 N03 11 000 Roof Coverings  
 N03 11 n00 - Types of Roofings [n = 1 to 4]  
           o roofing materials

#### N04 00 000 EXTERIOR CLOSURES

N04 10 000 EXTERIOR WALLS  
 N04 11 000 Exterior Wall Construction  
 N04 12 000 Interior Skin Construction  
 N04 13 000 Screen Walls  
 N04 14 000 Soffits & Facia  
 N04 15 000 Exterior Facades/Finishes  
           - Finish Materials (36 kinds)  
  
 N04 20 000 EXT BUILDING DOORS & FRAMES  
 N04 2n 000 Classes of Doors [n = 1 to 7]  
           - Types of Finishes  
             o Floor locations  
 N04 30 000 EXTERIOR WINDOWS  
 N04 3n 000 Classes of Windows  
           - Frame Materials & Types of Windows  
             o Floor locations  
  
 N04 40 000 EXT PORCHES & LOADING DOCKS  
 N04 41 000 Decks, Exterior Porches/Docks  
           - Decking Materials  
 N04 42 000 Railings, Exterior Porches  
           - Railing Materials  
 N04 43 000 Porch Support Members  
           - Support Materials  
 N04 44 000 Porch Columns  
           - Column Materials  
 N04 45 000 Misc:  
 N04 45 100 Balconies, Thresholds  
 N04 45 200 Fire Escapes  
           - Metal or Wood  
 N04 50 000 EXT ORNAMENTS  
 N04 51 000 Cornices  
           - Stone or Wood  
 N04 60 000 EXT STAIRS & RAMPS  
 N04 61 000 Stair/Ramp Railings, X  
           - Materials  
 N04 62 000 Steps, X  
           - Matr.s  
 N04 63 000 Handicap Ramps, X  
           - Matr.s  
 N04 70 000 EXT DOOR/WINDOW HARDWARE

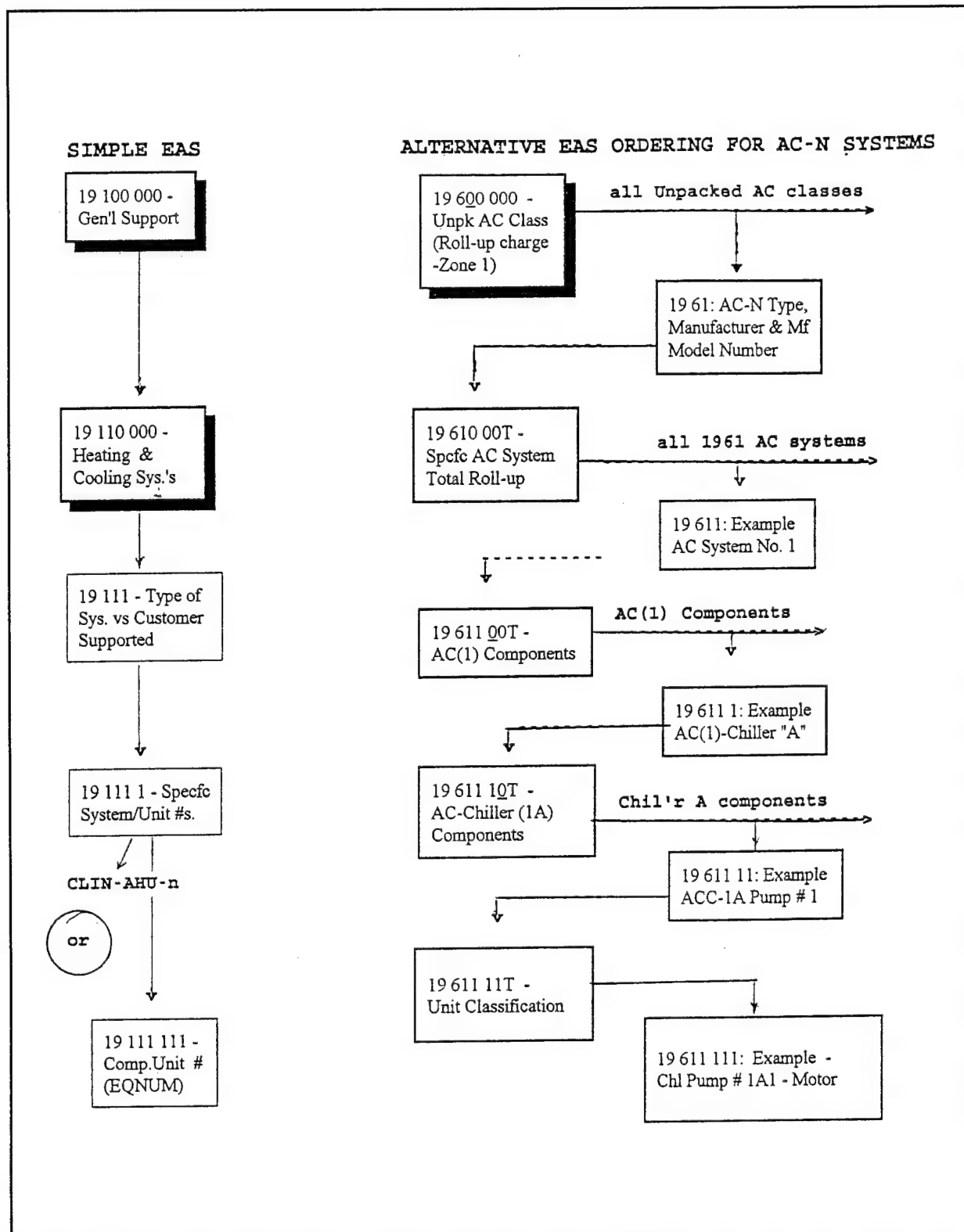


Figure B1. Ordering logic of EAS network numbering system-zone 1.

## N05 00 000 INTERIOR BLDG STRUCTURE &amp; HARDWARE

N05 10 000 BLDG WALLS/FIX-PARTITIONS/FLOORING, INT  
N05 11 000 Walls & Partitions, Int  
- Part. Materials  
N05 12 000 Bldg. Floors  
- Subfloors

N05 20 000 INT PARTITIONS, MOVABLE

N05 21 000 Movable Metal Partitions  
- Steel  
N05 22 000 Movable Fabric Partitions  
- same

N05 30 000 INT BLDG DOORS & DOOR FRAMES

N05 31 000 Metal D&F's  
N05 31 n00 - Type of metal & finish [n = 1 to 3]

N05 32 000 Fully Glazed Doors, Int  
N05 32 n00 - Type of frame material;  
o type of finish

N05 33 000 Wood Doors & Frames  
N05 33 n00 - Type of wood & finish [n = 1 to 3]  
o Hollow core

N05 34 000 Special (Type) Doors, Int  
N05 34 n00 - Types of Sp.Int.Doors  
N05 35 000 Roll-Up Int.Doors  
N05 35 n00 - Mtl(2) & Wood, Single & Double  
[n = 1 to 6]

N05 40 000 INTERIOR FIXTURES  
N05 41 000 Wood or Wood/Plastic  
- Cabinets/Ctrtops/Msc.  
N05 42 000 Metal  
- Medicine chest/cabinet

N05 50 000 FIREPLACES

N05 60 000 INT ORNAMENTS

N05 70 000 INT STAIRS

N05 80 000 INT HARDWARE

## N06 00 000 INTERIOR FINISHES

N06 10 000 WALL FINISHES

N06 1n 000 Types of int wall materials/finishes  
[n = 1 to A]

N06 20 000 FLOOR FINISHES

N06 2n 000 Types of int floor materials/finishes  
[n = 1 to A]

N06 30 000 CEILINGS & CEILING FINISHES

N06 3n 000 Types of int ceiling materials/finishes

[n = 1 to A]

# HNBE BUILDING EQUIPMENT

[Unknown]

# HNMD MEDICAL SUPPORT

[CACES NOT USED.]

# HNMS MECHANICAL SYSTEMS:

HNMS-S/T: SEWER/STEAM (UTILITIES)

## N07 00 000 UTILITIES

N07 10 000 SUPPLIER PROVIDED UTILITIES

N07 11 000 Natural Gas System

N07 20 000 MAMC PLANT/UNIT GENERATED UTILITIES

N07 21 000 Steam Plants, Heating/Power Generation

N07 21 100 Boiler (NG)

N07 21 200 Boiler (Coal)

N07 21 300 Boiler (Oil)

N07 21 400 Fuel Oil (FO) Boiler Equipment

N07 21 500 Boiler, Dual Fired

N07 21 600 Special Steam Generators & Enhancers

N07 21 700 Coal/Ash Handling Equipment

N07 21 800 Boiler Fd Wtr Additives

N07 21 900 Feed Water Supply

N07 21 A00 Deaerator

N07 21 B00 Blowoff

N07 21 C00 House Furnace (Gas)

N07 21 D00 HF (Oil)

N07 21 E00 HF (El)

N07 21 F00 Induction Furnace Gas/Oil

N07 21 G00 Surge Tank, 1000 Gallons

N07 22 000 Fixtures, Heating Generation

N07 23 000 Interconnections, HG

N07 24 000 Distr. Piping Sys, HG

N07 25 000 Unused

N07 26 000 El Power Gen Systems

N07 26 100 Engine Generator Sets

- Diesel

- Gasoline

GENPLANT NMAMC Emergency Generator Plant & Equipment

N07 26 200 Turbines

N07 26 300 Power Controls

TS/BPI-XXX Automatic Transfer & By-Pass Isolation Switch

[600 to 2000 Amps]

N07 37 000 Uninterruptable Power Sources

N07 37 100 Static Charger, Battery

N07 37 200 Motor Generator, Battery

N07 38 000 Emergency Battery Systems

- Wet

- Dry

HNMS-P: PLUMBING

N08 00 000 PLUMBING SUPPORT

N08 10 000 MSPS: SANITARY SYSTEMS

N08 1n 000 n = 1: Lavatory Equipment

2: Sinks

3: Main Waste Lines

N08 20 000 FRESH WATER SYSTEM, INTERIOR

N08 2n 000 n = 1: Supplier Interface System

2: Cold Water Distribution System

3: Spare

4: Hot Water (1 to A)

N08 30 000 RAIN WATER DRAINAGE SYSTEM

N08 3n 000 1: Fistures

2: Rain Drainage

3: Seepage Drainage

N08 40 000 SPECIAL PLUMBING SYSTEMS

N08 41 000 Compressed Air

N08 41 100 Simple CA

N08 41 200 Special CA Applications

N08 41 300 Heavy Duty Pipe/Fittings for CA

N08 42 000 Industrial Gases

N08 42 100 Simple Gas Compressor

N08 42 200 Hose, Ind Gasses

N08 42 300 P&F for IG

N08 50 000 SPECIAL KITCHEN PLUMBING SYSTEMS

N08 51 000 K Plumbing Fixtures

N08 51 100 K Sanitary Eq.

N08 51 200 K/Restaurant Dispensers

N08 51 300 K/R Water Softeners

N08 52 000 Laundry Plumbing Fixtures

N08 52 100 L Washing Systems

N08 53 000 Unassigned, Sp. Systems

N08 54 000 Fire Suppression, Sp. Systems

HNMS-H: HEATING, VENTILATION & AIR-CONDITIONING (HVAC)

N09 00 000 HVAC SYSTEMS

N09 10 000 HEATING FURNACES, NATURAL GAS (NG) N09 A1 n00 Fan Coils

N09 11 000 NG Supply System n = 9 to A

N09 12 000 NG Piping Systems N09 A1 B00 Unit Vents

N09 13 000 NG Heating Equipment N09 A1 C00 SZ Draw Thru

N09 A1 D00 Unit Heater

N09 20 000 HEATING FURNACE, FUEL OIL (FO)

N09 21 000	FO Supply System	N09 B2 000
N09 22 000	FO Distr.System	N09 B2 n00 Full Draft Fans
N09 23 000	FO Heating Equipment	SF - 1 to 7 Axial Vane Fans
		SF - 11 to 13 Central Fans
N09 30 000	HEATING FURNACES, LPG SYSTEMS	SF - 17 to 22 Louv & PH Fans
N09 31 000	LPG Supply System	
N09 32 000	LPG Heating Equipment	N09 B3 000 Distribution Systems
N09 40 000	STEAM HEAT (FROM A CENTRAL SOURCE)	N09 C0 000 Exhaust Systems
N09 41 000	Steam Heating & Processing Systems	N09 C1 000 Equipment, Ex.Fans
-	Steam-conversion Systems	
-	Flash Tanks; (FT - 1 to 14)	N09 D0 000 Humidifiers
-	Expansion Tanks	N09 E0 000 Controls & Instrumentation
o	air sep: AS - 1 to 19	
o	exp tanks: ET - 1 to 19	
-	Pumps (833 Units)	N09 F0 000 Testing & Balance
N09 42 000	Steam Cycling System, Heating	
	etc.	
N09 43 000	Steam Heat Output Systems	
	etc.	
N09 50 000	HEATED WATER (FROM A CENTRAL SOURCE): xxxxxxxxxxxxxxxxxxxxxxxx	
N09 51 000	HW Piping System	
-	pipe/ftgs/valves	
N09 60 000	EL HEATING SYSTEMS	
N09 61 000	Baseboard Heaters	
N09 62 000	Wall & Ceiling Heating Systems	
N09 63 000	Industrial Heaters	
N09 70 000	HEATING, SOLAR SYSTEMS	
N09 71 000	Equipment, Solar Systems	
N09 72 000	Piping, Solar Systems	
N09 80 000	OTHER HEAT GEN. SYSTEMS	
N09 90 000	COOLING GENERATION SYSTEMS	
N09 91 000	Equipment, CGS	
N09 92 000	Fixtures, CGS	
N09 93 000	Interconnecting PS; CGS	
N09 94 000	CGS Distr.	
N09 94 n00	Pipe Fittings	
1:	P&F	
2:	Gate Valves	
3:	Cooling Generation	
4:	Circulator Pumps	
N09 A0 000	HEATING & COOLING GENERATION SYSTEMS	
N09 A1 000	Equipment, H&C	
AHU-CLIN	Clinic Air-Handling Units	
AHU-	1 to 109	
N09 A1 100	H&Z Multi-Zone	
N09 A1 200	Dual Duct	
N09 A1 n00	n = 3 to D	

HNEL INTERIOR ELECTRICAL SYSTEMS,  
HIGH VOLTAGE (>600 Volts)

N10 00 000 INTERIOR ELECTRICAL SYSTEMS, HIGH VOLTAGE

N10 10 000	SERVICE & DISTRIBUTION POWER	N10 21 000	POWER DELIVERY COMPONENTS
INTERIOR		N10 21 100	Circuit Breakers (CB);
		six CB's.	
N10 11 000	MAIN FEEDER SWITCHES &		
N10 21 200	Safety Switches (5)		
CONTROL EQUIPMENT			
N10 21 300	Cntcts/Relay/Sw, HV		
N10 11 100	El.Power Panels	N10 22 000	POWER DRIVES (TBS)
N10 11 200	Switches & Disconnects		
N10 11 300	Main Feed Controls & Monitors	N10 30 000	Lighting Systems Supply
N10 11 400	Spare		
N10 12 000	OVERHEAD SERVICE FEEDERS		
N10 12 100	Cables		
N10 12 200	Channels		
N10 13 000	POWER PROTECTION EQUIPMENT		
N10 13 100	Switchgear, Mainframe (MSG)		
N10 13 110	MSG - 1200 Amps		
	Two primary 15 KV Switchgear Systems		
N10 13 120	MSG, Int.> 600 Volts		
	Eight double-ended substations.		
N10 13 200	Overload Protection Systems		
N10 13 210	Circuit Breakers, Branches & Main Lines		
N10 13 220	Fuze Protection, HV		
N10 13 230	Spare		
N10 13 300	Spare		
N10 14 000	TRANSFORMERS, HV		
N10 14 100	Liq.Filled Tx's, >600V		
N10 14 200	Dry Tx's, >15000 V		
N10 14 300	Dry Tx's, 600V to 15K Volts		
N10 14 400	Spare		
N10 15 000	Spare		
N10 16 000	Spare		
N10 17 000	LIGHTNING PROTECTION		
N10 17 100	Switchgear, Indoor, >600V		
N10 17 200	Spare		
N10 18 000	POWER & LIGHTING (P&L) DISTRIBUTION		
N10 18 100	P&L Indoor Switchgear, >600V		
N10 18 110	Sw.s & Receptacles		
N10 18 120	O'load System		
N10 18 130	Spare		
N10 18 200	P&L Feeder Lines		
N10 18 2n0	Cables, 3 types		
N10 18 300	P&L Branch Wiring		
N10 18 310	Branch Wiring, >600V		
N10 18 400	Buss Duct		
N10 18 500	Conduit EMT		
N10 18 600	Spare		
N10 19 000	SPECIAL INSTR. & EQUIPMENT		
N10 19 100	Usage Meters		
N10 19 200	Spare		
N10 19 300	Inverters, >600V		
N10 19 400	Rectifier, >600V		

N10 20 000 POWER SYSTEMS

HNEL INTERIOR ELECTRICAL SYSTEMS,  
LOW VOLTAGE (<600 Volts)

N11 00 000 INTERIOR ELECTRICAL SYSTEMS, LV

N11 10 000 Service & Distribution Power, <600V

N11 11 000 Main Feeder Switching & Control Equipment

N11 11 100 Electrical Power Panels

PANEL-01: 27 PANEL BOARDS

PANEL-03: 25 "

PANEL-04: 50 "

PANEL-05: 48 "

PANEL-06: 46 "

PANEL-07: 02 "

PANEL-08: 08 "

PANEL-10: 09 "

PANEL-11: 03 ANESTH. POWER CENTERS

12 POWER CENTERS

PANEL-12: 26 PANEL BOARDS

N11 11 200 Switches & Disconnects

11 SWITCHBOARDS

N11 11 300 Main Pd Controls & Monitors

N11 11 400 Spare

N11 12 000 Overhead Service Feeders

n11 12 100 El. Cables

N11 12 200 El. Conductor Channels

N11 13 000 Power Protection Equipment

N11 13 100 Switchgear, Mainframe (3)

N11 13 200 Overload Protection Systems

CB's and Fuzes

N11 14 000 TRANSFORMERS, LP (<600v)

N11 14 100 Tx, Liq

N11 14 200 Tx, Dry

TX-01: 18 Transformers

TX-02 02 "

TX-03: 06 "

TX-04: 08 "

TX-05: 02 "

TX-06: 02 "

TX-07: 00

TX-08: 08 "

TX-09: 03 "

TX-10: 00

TX-11: 00

N11 15 000 ?

N11 16 000 Spare

N11 17 000 LIGHTNING PROTECTION

N11 17 100: Indoor Switchgear

N11 17 200 Spare

N11 18 000 P&L Distribution

N11 18 100 P&L Control & Protection Eq.

N11 18 110 Power Sw. & Receptacles

n11 18 120	Lt Sw & Dimmers	
N11 18 130	P&L overload System	
N11 18 140	Spare	
N11 18 200	P&L Feeder Lines	
N11 18 210	El Cables	
N11 18 220	Cable, Flex/Metallic	
N11 20 000	POWER SYSTEMS, < 600V	N11 32 000 INDUSTRIAL FIXTURES
N11 21 000	Power Delivery System (PDS)	N11 32 100 Incand. LFs
	Components	N11 32 200 Fluorescent LFs
N11 21 100	PDS Circuit Breakers	N11 32 300 Quartz LFs
	N11 32 400 HID LFs	
N11 21 200	PDS Safety Switches [4 SS's;	N11 32 500 Sodium Arc (NA) Lamps
	1 LV Cartridge, 1 Plug Fuze)	N11 32 510 NA - HP (250 WATTS)
N11 21 300	Cntcts, Relays, Switches	N11 32 520 NA - LP (200 WATTS)
N11 21 310	Contactors/Relays	
N11 21 320	Switch Wiring	N11 32 600 Exit LFs
N11 21 330	Transfer Switches	
N11 21 340	Emerg. Power Tx Switch	N11 32 700 Emerg. LFs
N11 21 400	Receptacles and Plugs	N11 40 000 GROUNDING SYSTEMS
N11 21 410	Same	
		N11 41 000 El Service Ground
N11 21 411	Critical Care Receptacles (CCR):	N11 42 000 Bldg Structure Ground
	CCR Group: 78 OUTLETS	N11 43 000 Lightning Protection
N11 21 412	General Care Receptacles (GCR)	N11 44 000 Computer System Ground
	GCR Group: 14 OUTLETS	N11 45 000 Special Ground Systems
	GCOUT-1: 01 "	
	GCOUT-2: 04 "	N11 50 000 APPL.CONNECTIONS/POWER-SUPPLIES
	GCOUT-5: 04 "	
	GCOUT-6: 03 "	N11 51 000 Kitchen Fixtures
	GCOUT-7: 02 "	N11 51 100 Sanitary Equipment (Kitchen)
	---	N11 51 110 Dishwashers, Residential
	GCOUT-12: 116 "	N11 51 120 Dishwashers, Commercial
N11 21 413	Wet Area Receptacles (2)	N11 51 130 Pot/Cart Washer
		N11 51 140 Waste Disposals, Residential
N11 22 000	POWER DRIVE APPLICATIONS	N11 51 150 Waste Disposals, Commercial
N11 22 100	Motor Starter (MS)	N11 51 200 Food Prep Appliances
N11 22 110	MS - 0-600 V	N11 51 210 Blender/Pulpers
	07 Motor Control Centers	N11 51 220 Meat Slicer/Choppers
	03 AHU Variable Freq.Drives (VFD)	N11 51 230 Grinders/Tenderizers
	01 Irig.Pump VFD	N11 51 240 Meat Patty Makers
	07 Well Pump VFD	N11 51 250 Veg.Peeler/Choppers
		N11 51 260 Mixers
N11 22 200	Valve Actuators, El. Driven	N11 51 270 Coffee Grinder
N11 22 210	Solenoid Valve Actuators	N11 51 280 Coffee Maker
N11 22 220	O/C Rotational Valve Actuator	
N11 22 230	Position Controlled Valve Act.	N11 51 300 El Cooking/Baking
N11 22 240	Spare	N11 51 310 Convec. Ranges
		N11 51 320 Microwave Oven
N11 22 300	Centrifugal Pump Drives,	N11 51 330 Hot Top Range
	AC Motors	N11 51 340 Stack Oven
N11 22 310	Insp. of Motor Operation	N11 51 350 Spare
N11 22 320	Visual Insp of El Connections	N11 51 360 El Grill/Griddle
N11 22 330	PM of El Motor Comp.s	N11 51 370 El Fry Pan
N11 22 340	Spare	N11 51 380 El Deep Fat Fryer
N11 22 350	Replacement of Pump Motor	N11 51 390 El Boiler/Steamer
		N11 51 3A0 Sliced Bread Toaster
N11 22 400	Reciprocal Pump Drives,	N11 51 400 Food Warmers (5)
	AC El Motors	
N11 22 410	VI of Rotor & Field Coils	
N11 22 420	VI of El Connections	N11 51 500 El Service Systems

N11 22 430	PM of Motor Comp.s	N11 51 510	Tray Conveyor
N11 22 440	Repl of AC Motor	N11 51 520	Timers
N11 22 500	Vent Fan & Air Blower Drives	N11 51 530	Spare
N11 23 000	Spare		etc.
N11 30 000	LIGHTING SYSTEM	xx	
N11 31 000	Office Lighting Fixtures		
N11 31 100	Incandescents		
N11 31 110	Light Standard, < 150 Watts		
N11 31 120	Flood Lamps, > 150 Watts		
N11 31 200	Spare		

## Appendix C: Trial Applications I Through IV, Using Current MAMC-DPW Data Base Records

### Examples of Best-Fit Eas Operations Network Configurations

<u>TRIAL</u>	<u>SKILL</u>	<u>EAS NUMBER FORMAT</u>	<u>PAGE</u>
I	UTILITIES	Z S G - M C - N E P	51
II	PLUMBING	Z S - M C T - N E 0	53
III	HVAC	Z S G - M C - N F E	54
IV	INTERNAL ELECTRICAL	Z S - M C T - Y N E	55
V	SP.SYSTEMS (Communications)	Z S - M C 0 - 0 0 0	56
VI	CONVEYANCES	Z S - M C 0 - 0 0 0	57

### TRIAL APPLICATION I:

SINGLE ZONE ANALYSIS,  
UTILITY SERVICES EXAMPLE

ZSG - MC - NEP: Zones/Skills/Skill Category - System Category/ Specific Class & Types of Systems -  
Specific System Type & Location/Specific System Unit/ Component List & Status.

07 0 00 000 Z = 0 (Single Zone); S = 7 (Utilities): Provides a record for the Total Utilities roll-up of  
costs or hours for all Zones and Utility Systems.

07 n 00 000 UTILITY SERVICES: RESPONSIBLE SOURCE (G)

07 1 Base Plant/Unit Generated Lighting Utilities

07 2 Base Plant/Unit Generated Electrical Heat & Power\*

07 3 Base Stored Energy Systems

07 4 Base Natural Gas (NG) Base Distributions

07 5 Base Oil Fuel (OF) Distribution

07 6 Base Potable Water Systems Distribution

07 7 Base Non-Potable Water Distribution

07 8 Base Sewage System

07 9 Spare

07 A Supplier Provided Lighting Utilities

07 B Supplier Provided Electrical Power

07 C Supplier Provided Electrical Heating

07 D Supplier Provided Stored Energy Systems

07 E Spare

07 F Fuel Oil Heating Supplies

07 G Natural Gas Supplies

07 W or H Non-Potable Water System

---

\* Asterix indicates the entry which is selected as the development example.

07 S or I      Sewage Support Systems (External)

For n(3rd level) = 2

072 00 000      Base Plant/Unit Generated Electrical Heating & Power (System Class)

072 00 00T      Plant/Unit Generated Electrical Heating & Power \_\_\_\_ Total Charges.

**072 00 000      Base Steam-Plant/Unit-Generated Electrical Heating & Power**

072 n0 000      Steam Plants, Heating/Power Generation (M)

For n(4) = 1:

072 10 000      Designates Steam Plant # 1.

---

072 1n 000      Class of Systems - Boilers (C)

n(5) = 1\* to 8 [Gas-fired (GFB) to Dual Boiler (DB) systems].

---

072 11 000      Gas Fired Boilers (GFB)

072 11 00T      Total GFB Charges

072 11 n00      GFB System Types (n = 1 to 6) (N)

- All the Children of 072 11 00T.

For n(6) = 1:

072 11 100      GF Boiler System Type 1

[Parent of 07 211 10(T/L)]

072 11 10T      Boiler System Type 1 - Charges for all 10 Type 1 Boilers

(Parent of all 07 211 1n0 entries)

072 11 10L      Parts List for 07 211 000, Type 1, Boiler

(No children)

072 11 1n0      The Specific Boiler System; Unit # n, (E)

n(7) = 1\* to 10 (where "A" = 10).

072 11 11I      Description - List of Components

(per Inventory) for GFB Unit # 1.

072 11 110      Breakdown of Components for GFB Unit # 1

072 11 11n      Component-designation "n" for GFB Unit #1 (P)

## TRIAL APPLICATION II: SINGLE ZONE ANALYSIS PLUMBING SERVICES EXAMPLE

Z S - M C T - N E 0:	Zones/Skills - Categories/Classes of Systems/Types of Systems - Specific Systems of Type T (for Loc.L)/Specific Equipment Unit #s/Spare
08 000 000 Z = 0; S = 8	(PI Services);M = 0 (Categories of PI Services): Provides a record for the Total Plumbing Services roll-up of costs or hours for all Zones and Plumbing Systems.

08 000 000	PLUMBING SERVICES: RESPONSIBLE SOURCES	
08 n00 000	Categories of Major Systems	(M)
08 100 000	Sanitary Systems*	
08 200 000	Fresh Water System, Interior	
08 300 000	Rain Water Drainage	
+		
08 100 000	Sanitary Systems	
08 1n0 000	Types of PI Systems	(C)
08 110	Lavatory Fixtures*	
08 120	Utility Sinks	
08 130	Waste & Vent Systems	
08 140	Water Supply, Sanitary System	
+		
08 110 000	Lavatory Fixtures	
08 110 n00	Type of Fixture (n = 1* to 8)	(T)
08 111 000	WC - Tankless (Fixture Type)	
08 111 n00	Specific Type n - Model & Manufacturer	(N)
08 111 10T	WC Type 1 Total Charge	
08 111 1n0	Specific WC Fixture: Unit # n.	(E)
08 111 1nL	Location (Bldg/Floor/Room)	

\* Asterix indicates the entry selected as the development example.



**TRIAL APPLICATION IV****INTERIOR ELECTRICAL MAINTENANCE,  
LOW VOLTAGE**

Z S -M C T- Y N E: Zones/Skills - System Category/System Class/Type of System - T Subsys-  
tems/Specific System/Specific Equipment for N.

00 Z = 0; S = 0: Provides Total Maintenance Recorded Costs or Hours, For All Zones, Skills and  
Systems.

n0 Z = n; S = 0: Indicates entry is as above but only for Zone z, where z = 1- G.

0B 000 000 Interior Electric, Low Volt(<600Volts); IE Totals, All Zones (AZ).

0S M

0B 1 Service & Distribution Power, <600Volts  
0B 2 Power Systems, <600V  
0B 3 Lighting Systems  
0B 4 Grounding Systems  
0B 5 Power Supplies & Appliance Connections  
0B 6 [Spare]  
Parent to all  
0B 100 Service&Distr.Power, <600Volts, AZ. < ZB 100 000  
entries

0S MCO

0B 110 Main Feeder Switching & Control  
0B 120 Overhead Service Feeders, AZ  
0B 130 Power Protection Systems, AZ  
0B 140 Primary Transformer Systems, AZNo Children  
0B 150 Spare  
0B 160 Spare  
0B 170 Lightning Protection, AZ  
0B 180 P&L Distribution, Interiors, AZ  
0B 190 Special Equipment, AZ

FOR Z = A:

ZS MCT 000

AB 110 000 Main Feeder Switching & Control Systems, AZ.  
AB 110 00T EI Power Panel Charges (Collection point)  
AB 111 000 EI Power Panels  
AB 112 000 Switches & Disconnects  
AB 113 000 Controls & Monitoring Devices

ZS MCT YNE

AB 111 n00 Type of Power Panel (n = 1 - 9)  
AB 111 100 Type of Power Panel, Type #1  
AB 111 1n0 Specific Panel Group & its Customer (n = 1 to G)  
AB 111 110 Panel/Customer 1  
  
AB 111 11n Specific Power Panel (EQNUM), n = 1 to G.  
AB 111 111 Power Panel No. 1 (for Panel Type #1).

**TRIAL APPLICATION V**

SPECIAL SYSTEMS, INTERIOR ELECTRICAL MAINTENANCE,

COMMUNICATIONS:

Z S -M C T- Y N E: Zones/Skills - Category or Class of Systems/ System or Subsystem/Equipment/Parts  
ID.

0C 000 000 Special Interior Electrical Systems; Total for all Zones.

0SM

0C1 Sound Systems\*

0C2 Alarm Systems

0C3 Television Systems

0C4 Control Systems

0C5 Omitted

0C6 Clock &amp; Program Systems

0S MC

0C 100 Sound Systems

0C 110 Telephones\*

0C 120 Intercoms

0C 130 PA Systems

0C 140 Radio Communication Systems

0C 150 Audio Signalling Systems

|

|

v

TBS

-----  
\* Asterix indicates the entry which will be selected  
as the development example.

**TRIAL APPLICATION VI:**

## CONVEYANCES &amp; OTHER SPECIAL EQUIPMENT

Z S -M C T- Y N E: Zones/Skills - Category/Class of Systems/Type of System or Subsystem/Equipment Unit.

0D1	Human Conveyances*
0D2	Message/Data Conveyances
0D3	Freight/Bulk Conveyances
0D4	Spare
0D 100	Human Conveyances
0D 110	Elevators/Lifts
0D 120	Escalators
0D 130	Crawl-Space Transport Vehicles*
0D 200	Data Conveyances
0D 210	Pneumatic Tubes
0D 220	Automated Box Conveyors (ABC)
0D 300	Freight Conveyances
0D 310	Freight Elevators
0D 320	Automated Transport System (ATS)
V	
TBS	

-----  
\* Asterix indicates the entry which will be selected as the development example.

---

END

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ATTN: CECPW-FT  
ATTN: CECPW-ZC (2)

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D.D. Eisenhower	Fort Gordon, GA
Fitzsimmons	Aurora, CO
Madigan	Fort Lewis, WA (5)
Walter Reed	Washington, DC
Womak	Fort Bragg, NC
Tripler	Oahu, HI
Landstuhl Regional	Germany